N95

NUTRITIONAL SUPPORT TEAM POLICY AND PROCEDURE MANUAL

Veterans' Administration Medical Center, West Side
820 So. Damen Avenue
Chicago, Illinois 60612

NEWARK PUBLIC LIBRARY

APR 1 1986

U. S. GOVT. PUBS.
DEPOSITORY 376

Compiled By: Katy Emmons, Pharm. D.
Mary Lou Ebbert, Pharm. D.
Maria L. Ule, R.N., C., B.S.N.
Sherry Chan, R.D.
Benita Reed, B.S.N. C.I.C.

Team Director: Phillip E. Donahue, M.D.

VA1.10:

READEX FICHE best copy available

		Page
Objectives		1-2
Team Position Descriptions -	Physician	3
	Pharmacist	4-5
	Nurse	6-7
	Dietitian	8-9
	Nurse Epidemiologist	10-11
Nutritional Evaluation -	Initial Nutritional Assessment	12
	Nutritional Assessment	14
	Nutritional Requirements	18
Enteral Nutrition Support -	Sample Formula Composition	21
	Administration-(See Nursing Section on feeding tubes)	
	References	22
Parenteral Nutrition Support -	Introduction and Ordering	23
	Solution Component Availability	25
	Administration (See Nursing Sections on Insertion and Maintenance of the CVP Line)	
	Complications	32
Nursing Care -	Introduction	46
Enteral Nutrition -	Feeding Tubes	48
	Intermittent vs. Continuous Feeding	48
	Patient monitoring	52
	Dressing Changes	52
	Complications	53
Parenteral Nutrition -	General Considerations	54
	Patient Monitoring	58
	Complications	59
	CVP Catheter Insertion	61
	CVP Catheter Maintenance	64
	Administration with a pump	66
References		
Infection Control - Intravascular -	Introduction	77
	Host Factors	77
	Cardiovascular Alterations	77
	Associated Procedures/Devices	78
	Pathogens	81
	Septic Complications	82

		Page
Gastrointestinal -	Introduction	83
	Tube Feeding Routes	83
	Formula Storage	84
	Feeding Systems	84
	Complications	84
	Culturing	85
References		86
Appendices -	Appendix I - Hyperalimentation Checklist	87
	Appendix II - Physician Order Sheet	88
	Appendix III - Intake and Output Sheet	89
	Appendix IV - Nursing Care Plan	90
	Admission Data	90
	T.P.N.	91
	Enteral	94

Nutrition Support Team (NST) Objectives

PATIENT CARE

1. Prior to initiation of total nutrition support, the NST will perform a nutritional assessment based upon established metabolic and physical parameters.

2. The NST will establish the appropriate route of alimentation based upon assessment of metabolic and physical parameters.

3. The NST will use metabolic and physical parameters to determine the appropriate formulation of total parenteral nutrition and enteral feeding solutions.

4. The NST will make periodic rounds on all patients receiving total nutritional support (TNS).

5. The NST will monitor metabolic and physical status of patients on TNS using the metabolic flow sheet established by the team.

6. The NST will document at least weekly in the patient's medical record the progress of each patient on TNS based upon metabolic and physical parameters.

7. The NST will maintain records of all patients treated with TNS and will make yearly retrospective audits on randomly selected patients records.

8. The NST will submit quarterly reports to the Quality Assurance Committee on patients who receive TNS in order to provide data on cost effectiveness and/or quality control.

EDUCATION

1. The NST will provide a formalized in-service educational program at least yearly to the professional staff.

2. The NST will provide a file of current literature on TNS to be available in the pharmacy conference room.

3. The NST will provide written guidelines for the use of TNS which will be provided to the professional staff.

4. The NST will meet at least monthly for administrative and educational purposes. Minutes will be recorded and on file in the pharmacy conference room.

RESEARCH

1. The Nutrition Support Team will prepare protocols for approval by the Human Research Committee for the initiation of clinical nutritional research.

2. The Nutrition Support Team will establish protocols for retrospective and concurrent analysis of patients treated with enteral and parenteral nutrition.

Position: Nutritional Support Physician

DUTIES AND RESPONSIBILITIES:

1. Makes periodic rounds on patients receiving specialized nutrition support with the pharmacist, nurse and dietitian members of the team.

2. Evaluates new patient data obtained by team nurse, pharmacist and dietitian aimed at:

   (a) Approval of necessity for specialized feeding.

   (b) Assisting in selection of route and technique of feeding.

3. Coordinates nutrition support goals with patient's primary care physician via the support team; arbitrates differences of opinion concerning adequacy of therapy

4. Directs monitoring of patients in conjuction with primary care physician.

5. Interacts with Pharmacy, Dietetic, Nursing and Clinical Chemistry Services for professional advice concerning procurement of adequate solutions, hardware, lab studies, etc. Specifically assists in designation of standardized TPN solutions which will be used in every patient unless a specific exception is noted. Specific exceptions may include renal failure, hepatic failure and others.

6. Provides ongoing education by in-service training to other hospital staff in conjuction with the team.

7. Supervises periodic reviews to determine effectiveness of nutritional support as deemed appropriate.

8. Is available on request for further consultation with primary care physician.

9. Performs research and clinical investigation, as appropriate, when nutritional questions and/or problems arise.

POSITION: Nutritional Support Pharmacist

QUALIFICATIONS:

A. Education

1. Meets educational requirements for the Pharmacist GS-660 Series.

2. General pharmacy experience including involvement in nutritional support services.

B. Essential Characteristics

1. Experience and interest in the administration, preparation, and in the monitoring processes of patients on nutritional support.

2. Successful experience in communication skills and teaching in a hospital setting.

3. Experience in providing pharmacy guidelines for total nutritional support.

C. Research

1. Ability to gather, compile and analyze data.

2. Written and oral skills to provide documentation on research activities.

DUTIES AND RESPONSIBILITIES:

A. Collaborates with other team members on the initial nutritional and metabolic assessment of potential candidates for nutritional support

B. Assists in the development of a nutritional plan and therapeutic objectives for each patient seen by the nutritional support team.

C. Designs and recommends specific parenteral nutrition regimens including solution composition, formulation and administration.

D. Collects and records monitoring parameters for each patient on nutritional support and evaluates patients for efficacy, safety and complications. The monitoring process will include a review of the patient's clinical state, fluid balance, laboratory data, drug therapy, concurrent non-drug therapy, and other appropriate parameters.

E. Identifies potential drug/drug and food/drug interactions in patients monitored for nutritional support.

F. Recommends modifications to nutritional regimens based on patient monitoring.

G. Coordinates preparation of parenteral nutritional solutions in the pharmacy and assures the use of proper techniques and procedures.

H. Reviews, evaluates and recommends enteral and parenteral nutrition products for efficacy, ease of use and cost effectiveness. Submits recommendations for formulary changes when appropriate.

I. Trains and supervises pharmacy fellows, residents and advanced degree students rotating on the nutritional support team.

J. Develops, conducts and coordinates in-service education programs for medical staff, residents, and students; pharmacy, nursing, and dietary staff.

K. Develops protocols, conducts and participates in nutritional and metabolic research with the goal of publications.

L. Develops patient and pharmacy profile systems for monitoring and documentation purposes.

M. Is responsible for administrative aspects of the team and fiscal reporting.

N. Participates in nutritional support rounds with other members of the team.

O. Serves as liaison between the nutritional support team and the Pharmacy Service and maintains close communication with the Chief, Pharmacy Service.

P. Regulates parenteral nutrition orders and related therapy based upon timing of administration of solutions to prevent wastage of solutions.

Q. Advises the nutritional support team on available solutions.

Position: Nutritional Support Nurse Clinician

QUALIFICATIONS:

A. EDUCATION

1. Current license to practice professional nursing.
2. A minimum of 3 years of successful nursing practice, primarily in Medical/Surgical areas.
3. Strong interest or previous experience in nutritional support, I.V. therapy and aseptic techniques.
4. A Baccalaureate Degree in Nursing is desirable.

B. ESSENTIAL CHARACTERISTICS

1. Experience and interest in administering parenteral and enteral nutritional support.
2. Ability to function independently within established guidelines.
3. Knowledge of clinical and administrative nutritional support procedures and protocols as they relate to Nursing Service responsibilities.
4. Ability to provide nursing guidelines for total nutritional support.
5. Excellent written and verbal communication skills.
6. Ability to collaborate effectively with other disciplines in activites aimed toward the developement and maintanence of the patient nutritional support programs.

C. RESEARCH

1. Ability to obtain, compile and analyze data to determine need for modification of current approaches to therapy based on the outcome.

DUTIES AND RESPONSIBILITIES:

A. Serves as a liaison between the nutritional support team and Nursing Service.

B. Assist Medical and Nursing Personnel with monitoring patients on peripheral TPN therapy, making sure that peripheral sites are changed every 72 hours and that complications are reported - i.e., swelling, pain, phlebitis, sepsis, etc.

C. Assist the Nursing staff in the development of care plans for the enteral and parenteral nutritional support patient.

D. Confers with the ward physician, dietitian, pharmacist and ward nurses in initiating and maintaining enteral nutrition on those patients who would benefit from its use.

E. Assist with patient teaching for home enteral feeding regimes.

F. Communicates with ward physician, ward nurses, the nutritional support team and significant others to resolve problems or concerns related to total nutritional support.

G. Acts as a resource person to ward personnel for effective administration of total nutritional support.

H. Attends educational programs and participates in professional organizations to keep abreast of new developments in the areas of TNS and assist with the formulation of standards of care.

I. Assist with the evaluation of new products and equipment for enteral and parenteral use and assist with determining their feasibility for use.

J. Assist with establishing research protocols to improve or evaluate the delivery of nursing care to those patients receiving total nutritional support.

POSITION: Nutrition Support Dietitian

QUALIFICATIONS:

A. Education

1. Registered Dietitian (B.S. Degree in Nutrition followed by successful completion of national registration examination).

2. Two (2) to three (3) years experience in hospital setting, primarily in medical / surgical / oncological areas.

3. Experience in enteral and parenteral support.

B. Functions

1. Knowledge of the complex phase of the principles and practices of clinical dietetics.

2. Knowledge of available parenteral and enteral products composition, indications, usage, contraindications, administration, etc.

3. Knowledge and the ability to interpret significance of normal or abnormal laboratory and anthropometric values related to nutritional status or support.

4. Ability to identify individuals at nutritional risk using pre-established nutritional assessment criteria and from this establish nutritional requirements and nutritional care plan.

5. Knowledge of the aspects of enteral and parenteral support as they relate to clinical dietetics.

C. Research

Ability to gather, compile and analyze data and to modify current approaches to therapy based on outcome.

DUTIES AND RESPONSIBILITIES:

A. Assist primary care physicians with the nutritional management of patients on enteral and parenteral support.

B. Nutritional Assessment utilizing anthropometric measurements, laboratory determination and other pertinent data to generate metabolic profiles and provide direction for nutritional management.

1. Initial assessment to establish baseline parameters and to calculate nutritional requirements and deficits of the patients.

2. Subsequent assessment to monitor and evaluate efficacy of nutritional support and to provide current information regarding nutritional status of the patient.

C. Advise in nutrition care planning by making recommendations on patient's nutritional support to satisfy their nutritional requirements.

D. Provide information regarding available enteral products, ranging from supplementary oral feeding to nutritionally complete tube feedings.

E. Communicate with other team members and advise adjustments in therapy within the recommendations of established protocol and goals of the ward physician.

F. Participate in rounds with other team members to monitor patient progress.

G. Counsel and educate physicians, medical students, para-professionals, etc. on the topics of nutritional support and nutritional management.

H. Chart information in medical records regarding recommendations, nutritional assessment/status of patient, patient progress, and other pertinent information.

I. Maintain nutritional profiles on patients.

J. Participate in inservice education.

K. Assist in the development of protocols and papers.

L. Assure compliance with established protocol and technique.

M. Maintain up to date records of patients receiving enteral nutrition.

N. Participate in educating and counseling patients and family members on home enteral feeding regimens.

O. Attend and participate in local, state and/or national meetings; or enroll advanced courses pertinent to nutrition and/or nutrition support.

POSITION: Nurse Epidemiologist

DEFINITION

The Nurse Epidemiologist (Nutritional Support Team) is a registered nurse who has knowledge of the infectious diseases related to the nutritionally deficient patient and the pertinent principles of epidemiology.

REQUIREMENTS

1. Current registration as a professional nurse.
2. Three to five years of Med/Surg experience (including administration of total nutritional support) and one to two years of epidemiological nursing practice.
3. A baccalaureate degree in Nursing is desirable.
4. Experience and interest in administering both parenteral and enteral nutritional support.
5. Successful experience in supervision and teaching in a hospital setting.
6. Experience in providing infection control guidelines for total nutritional support.

DUTIES AND RESPONSIBILITIES

A. Provide infection control guidelines for Total Parenteral Nutrition (TPN) therapy including intravascular catheter placement, intravascular catheter care, solution preparation and tubing and dressing changes.

B. Provide infection control guidelines for enteral nutritional support therapy including feeding tube placement, feeding tube care, feeding preparation, feeding bag changes and specimen collection.

C. Provide guidelines for methods and frequency of culture specimen collection.

D. Evaluate and document efficacy of Nutrition Support Service procedures and techniques with regards to minimizing infections.

E. Monitor culture results and communicate them to the Nutrition Support Team, primary service and the infection control committee.

F. Participate with other Nutrition Support Team members in developing Medical Center policies and procedures for safe, effective nutritional support techniques.

G. Establish research protocols for study to improve infection control measures for patients receiving nutritional support.

H. Provide multidisciplinary staff education and training regarding infection control aspects of nutritional support.

I. Provide patient/family education regarding nutritonal support measures to prevent infection.

J. Participate in evaluation of new nutritional support products such as hyperalimentation catheters and feeding products.

K. Evaluate infected patients or those on antibiotic therapy who are also receiving nutritional support.

L. Provide resources for infection control practices to patients receiving nutritional support and personnel associated with them.

M. Attend ward rounds and share information with nutritional care implications with the staff.

N. Participate in professional organizations in order to keep abreast with current practices within the field and develop Medical Center standards based upon this information.

O. Gathers, compiles and analyzes data, in a systematic manner, then changes therapeutic approaches based on this research.

NUTRITIONAL EVALUATION

The basis for implementation of nutritional support is the identification of patient at risk for protein or protein-calorie malnutrition. Thus, prior to implementing enteral or parenteral nutrition, a nutritional assessment should be performed to determine the need for nutritional support and the form it should should take. Repeat assessment provides a method of monitoring the patients progress and efficacy of therapy.

- INITIAL NUTRITIONAL ASSESSMENT

The admission history and physical includes aspects of nutritional assessment which may help identify patients at high risk for malnutrition. Routine admission data should provide adequate information to assess nutritional status and to determine whether in-depth assessment is indicated.

Factors Indicating the Need for Formal Nutritional Assessment Consult are:

1. Serum albumin of less than 3.0 g/dl
2. Total lymphocyte count of less than 1500/mm
3. Recent loss of more than 10% of usual body weight.

Should the initial assessment reveal nutritional depleton, an in-depth nutritional assessment can be performed which includes the evaluation of diet history, laboratory data, anthropometric measurements, energy requirements and immunological tests.

See Table 1 for suggested guidelines for ordering a nutritional assessment. After review of the initial results, further recommendations can be made according to the nutritional assessment protocol.

NOTE THAT NO SINGLE TEST OR MEASUREMNT ACCURATELY REFLECTS THE PATIENTS' NUTRITIONAL STATUS AND THAT ALL OF THE TESTS ARE NOT APPROPRIATE FOR ALL PATIENTS.

TABLE 1

The following parameters are included in the nutritional/metabolic profile:

1. Height in centimeters.
2. Weight in kilograms.
3. Basal energy expenditure in kilocalories per day.
4. Actual weight as a percentage of ideal weight.
5. Actual triceps skinfold thickness as a percentage of the standard value.
6. Actual mid-upper arm muscle circumference as a percentage of the standard value.
7. Creatinine/height index.
8. Serum albumin level.
9. Serum transferrin level or total iron-binding capacity (TIBC).
10. Total lymphocyte count.
11. Measure of cell-mediated immunity (delayed hypersensitivity reaction).
12. Nitrogen balance.
13. Apparent net protein utilization.
14. Weight change as per cent of usual weight (with time).
15. Caloric intake as a multiple of basal energy expenditure.

During the course of therapy, a good protocol for the evaluation of the efficacy of nutritional therapy includes the following:

1. Daily - body weight.
2. Twice weekly - nitrogen balance.
3. Weekly total lymphocyte count, TIBC.
4. Every three weeks - anthropometrics, skin tests.

NUTRITIONAL ASSESSMENT

A. Visceral Protein

Because every molecule of protein in the body performs a vital function, the depletion of protein levels indicates a nutritional impairment. Indicators of visceral (non-muscle) protein status include:

1. Serum albumin

3.5-3.0 g/dl - mild depletion
3.0-2.5 g/dl - moderate depletion
<2.5g/dl - severe depletion

Serum transferrin - estimated from total iron binding capacity (TIBC) or measured by lab directly

= (TIBC X 0.8)-43

NOTE THAT THE CONSTANTS IN THIS EQUATION MAY VARY WITH INDIVIDUAL LABORATORIES.

2. Immune Competence

-Total lymphocyte count - derived from a differential blood count

$$= \frac{\% \text{ lymphocyte} \times \text{WBC}}{100}$$

-Cell mediated immunity

Adequacy of the cellular immune system is estimated by delayed cutaneous hypersensitivity to common recall antigens - such as trichophyton, mumps, candida, and tuberculin purified protein derivative (PPD).

B. Somatic Protein

1. Weight/Height

The patient's current weight should be used in conjunction with ideal body weight, usual weight and weight change over a specified period of time when assessing somatic status. Changes in the weight/height ratio reflect changes in fluid balance acutely.

To determine ideal body weight:

Build		Women	Men
Medium	-	100 lb. for first 5 ft. of ht., plus 5 lb. for each additional inch	-106 lb. for first 5 ft. of ht., plus 6 lb. for each additional inch
	-	45 kg + 2.3 kg/in	-50 kg + 2.3 kg/in
Small		subtract 10%	subtract 10%
Large		add 10%	add 10%

TABLE II

INSURANCE TABLES

1983 Metropolitan Height and Weight Tables (based on 1979 Build Study, Society Actuaries and Association of Life Insurance Medical Directors of America, 1980)

Men 25-59 Years

Height (feet/ inches)	Small Frame (pounds)*	Medium Frame (pounds)*	Large Frame (pounds)*
5' 2"	128-134	131-141	138-150
5' 3"	130-136	133-143	140-153
5' 4"	132-138	135-145	142-156
5' 5"	134-140	137-148	144-160
5' 6"	136-142	139-151	146-164
5' 7"	138-145	142-154	149-168
5' 8"	140-148	145-157	152-172
5' 9"	142-151	148-160	155-176
5'10"	144-154	151-163	158-180
5'11"	146-157	154-166	161-184
6' 0"	149-160	157-170	164-188
6' 1"	152-164	160-174	168-192
6' 2"	155-168	164-178	172-197
6' 3"	158-172	167-182	176-202
6' 4"	162-176	171-187	181-207

*In indoor clothing weighing 5 lbs. shoes with 1" heels

Women 25-59 Years

Height (feet/ inches)	Small Frame (pounds)*	Medium Frame (pounds)*	Large Frame (pounds)*
4'10"	102-111	109-121	118-131
4'11"	103-113	111-123	120-134
5' 0"	104-115	113-126	122-137
5' 1"	106-118	115-129	125-140
5' 2"	108-121	118-132	128-143
5' 3"	111-124	121-135	131-147
5' 4"	114-127	124-138	134-151
5' 5"	117-130	127-141	137-155
5' 6"	120-133	130-144	140-159
5' 7"	123-136	133-147	143-163
5' 8"	126-139	135-150	146-167
5' 9"	129-142	138-153	149-170
5'10"	132-145	142-156	152-173
5'11"	135-148	145-159	155-176
6' 0"	138-151	148-162	158-179

*In indoor clothing weighing 3 lbs. shoes with 1" heels

To Evaluate Changes in Weight:

a). The percentage of ideal body weight is calculated as follows:

$$\% \text{ of ideal body weight} = \frac{\text{actual weight}}{\text{ideal body weight}} \times 100$$

Similarly, the percentage of usual weight is derived:

$$\% \text{ of usual weight} = \frac{\text{actual weight}}{\text{usual weight}} \times 100$$

And the percentage of weight change is found:

$$\% \text{ of weight change} = \frac{\text{usual weight - actual weight}}{\text{usual weight}} \times 100$$

b). EVALUATION OF WEIGHT CHANGE*

Time	Significant Weight Loss	Severe Weight Loss
1 week	1-2%	> 2%
1 month	5%	> 5%
3 months	7.5%	> 7.5%
6 months	10%	> 10%

* Values charted are for percent weight change:

$$\text{Percent Weight Change} = \frac{\text{usual weight - actual weight}}{\text{usual weight}} \times 100$$

2. Anthropometrics

a). Triceps skinfold*

Fat stores are determined by measuring the triceps skinfold. (Table III)

The following indices to assess skeletal muscle status are preferred over standard weight-for-height, which are limited in nutritional assessment of obese or edematous patients.

b). Arm muscle circumference*

AMC= arm circumference-(0.314 x TSF in mm)
(Table III).

1. STANDARDS

Table III

STANDARDS FOR ANTHROPOMETRIC MEASUREMENTS

	Triceps Skinfold (mm)	Arm Circumference (cm)	Arm Muscle Circumference (cm)
Male	12.5	29.3	25.3
Female	16.5	28.5	23.2

*From Jelliffe, D.B.
†American standards have recently been developed. (Frisancho, A.R., Am J Clin Nutr 27(10) 1052, 1974).

c). Creatinine/Height Index

Creatinine excretion is related to the patient's muscle mass. If renal function is normal, a 24-hr. collection of urine can be assayed for the number of milligrams of creatinine; the percentage deficit is then calculated. This reflects the percentage of muscle deficit.

$$CHI = \frac{\text{Actual Urinary creatinine}}{\text{Ideal Urinary creatinine}} \times 100$$

(Table 4)

*At this time there are no standards for patients older than 44. Caution must, therefore, be exercised in applying these standards to elderly patients.

1. STANDARDS

Table IV

IDEAL URINARY CREATININE VALUES

Men*		Women†	
Height (cm)	Ideal Creatinine (mg)	Height (cm)	Ideal Creatinine (mg)
157.5	1288	147.3	830
160.0	1325	149.9	851
162.6	1359	152.4	875
165.1	1386	154.9	900
167.6	1426	157.5	925
170.2	1467	160.0	949
172.7	1513	162.6	977
175.3	1555	165.1	1006
177.8	1596	167.6	1044
180.3	1642	170.2	1076
182.9	1691	172.7	1109
185.4	1739	175.3	1141
188.0	1785	177.8	1174
190.5	1831	180.3	1206
193.0	1891	182.9	1240

*Creatinine coefficient (men) = 23 mg/kg of ideal body weight.
†Creatinine coefficient (women) = 18 mg/kg of ideal body weight.

3. Nitrogen balance

Nitrogen balance is used to determine daily nitrogen needs and to assess efficacy of nutritional support. Repair of significant protein deficits can only occur if the nitrogen balance is significantly positive. The goal for anabolism is a daily positive balance of 4-6 grams.

$$\text{Nitrogen Balance} = \text{Nitrogen In} - \text{Nitrogen Out}$$
$$= \frac{\text{protein intake in gram}}{6.25+} - (\text{UUN} + 3) - \text{other sources of loss*}$$

+6.00 for patients on TPN

*bowel fistula
pancreatic fistula

- NUTRITIONAL REQUIREMENTS

A. Energy

1. Requirements may be determined by calculating the basal energy expenditure (BEE) using the Harris-Benedict equation. The basal calculation is then multiplied by the activity and injury factors to account for increased energy requirements. Repeat calculation is suggested to assess changes in the patient's energy requirement.

BEE (men) = 66.78 - 13.75W + 5.0H - 6.76A X (Activity Factor x Injury Factor)

BEE (women) = 665.1 (9.56W) + 2.85H - 4.68A X (Activity Factor x Injury Factor)

W=weight in kg, if 10% loss, use usual weight in kilograms
H=height in cm
A=age in years

Activity Factor

Confined to bed = 1.1
Out of bed = 1.3

Injury Factor

Surgery
- Minor = 1.1
- Major = 1.1

Infection
- Mild = 1.2
- Moderate = 1.4
- Severe = 1.6

Trauma
- Skeletal = 1.35
- Head injury with steroid therapy = 1.6
- Blunt = 1.35

Burns

40% BSA	= 1.5
100% BSA	= 1.9

Weight gain goals should be less than or equal to one pounds per week. Weight gain greater than one pound per week are probably due to water retention.

2). SOURCES

Energy requirements may be met with carbohydrates, fat or a combination of both. Protein is usually not to be utilized or calculated as a source of calories since it is not to be used as a body fuel, but rather as a source of nitrogen. Carbohydrates and fat are equally effective in achieving nitrogen retention; some investigators advocate using a combination of carbohydrate and fat for calories.

1. Dextrose:

   25% is usually the final concentration in the parenteral nutrition solution for central line infusion. Thirty-five percent or greater final concentration is mainly used in patients on fluid restriction.

   Ten percent is the highest suggested concentration for peripheral hyperalimentation solutions. Fat emulsion piggybacked to this hyperosmolar solution will decrease the osmolarity and help reduce the incidence of phlebitis.

2. Fat:

   There are several advantages of using lipid as a source of energy.

   a. Lipid (10% or 20%) is an isoosmolar solution that does not cause thrombosis.

   b. Lipids do not need insulin for metabolism, this is beneficial in the glucose intolerant patient (diabetic, septic).

   c. Large glucose loads increase metabolic rate, CO_2 production, and ventilatory demand while lipid administration decreases CO_2 production per molecule metabolized.

   d. Lipid solutions do not cause hypoglycemia if discontinued abruptly.

   e. Lipid infusions prevent essential fatty acid deficiency (liver function abnormalities and skin rash) which may appear as early as one week after lipid-free parenteral nutrition. Fatty acid requirement can be met by the infusion of 2 - 3 500 ml bottles of 10% lipid per week.

   f. A 20% lipid solution provides 2.0 kilocalories per milliliter of volume and can be given by peripheral or central veins. 10% lipid supplies 1.1 kilocalories per milliliter.

A 25% dextrose solution provides only 0.85 kilocalories per milliliter of volume and must be given via central veins. Therefore, lipid solutions are beneficial in the fluid restricted patient. The 10% solution provides 550 kcal/500 ml. The 20% solution provides 1000 kcal/500 ml. Lipid may provide 40 - 50% of nonprotein calories.

B. Protein and Nitrogen

The daily protein and nitrogen needed for growth, maintenance or anabolism depends on age, nutritional status, metabolic needs and caloric contribution of non-nitrogen sources (glucose and fat).

1. Requirements

The recommended daily requirement for patients with normal renal and liver function is 6 - 18 g of nitrogen/day or 40 - 112 g of protein/day. (1 gram of nitrogen = 6.25 gram of protein).

Table V

RECOMMENDED DAILY PROTEIN INTAKES

clinical type	amino acids g/kg/day	urinary nitrogen loss g/day	NCP:N kcal:N
nondepleted, post-operative	1.0	5	150:1
nutritionally depleted	1.2-1.5	5-10	100-150:1
hypermetabolic (severe stress, infection)	1.5-2.0	10-15	100-80:1

The goal of nutritional support is to put the patient in positive nitrogen balance or at least in nutritional equilibrium. Thus, nitrogen intake must meet urinary losses. The quantity of protein needed daily can be determined by collecting a 24 hour urine sample for urea nitrogen analysis. A positive nitrogen balance of 4 - 6 g/day is considered sufficient.

The non-protein calorie:nitrogen ratio (NPC:N) must be considered in nutritional support (Table V). The recommended NPC:N ratios range from 100:1-250:1 with 150:1 as the most accepted ratio. In patients with renal failure, the NPC:N is increased to 350-500:1 depending upon the patient's ability to utilize protein for anabolism and the frequency of dialysis. Dialysis procedures remove proteins from the bloodstream. Therefore, the protein dose may be altered to compensate for these losses.

Patients with liver disease should not receive more than 40 - 50 g of protein per day in order to prevent serum amino acids inbalances, metabolic alkalosis, pre-renal azotemia, hyperammonemia and ultimately encephalopathy.

C. Fat

The indications for fat emulsion usage in patients receiving parenteral nutrition are to treat or prevent essential fatty acid deficiency (EFAD) and to provide calories. When used to prevent EFAD, fat emulsions should provide 8 - 10% of the total NPC. When dextrose alone is the source of NPC, EFAD may develop. If this kind of regimen is followed for greater than two weeks, it is recommended that at least two 500 ml bottles of 10% fat emulsion be provided weekly to prevent EFAD. When used s a source of calories, fat emulsion should not constitute more than 50% of the daily calorie intake.

500 ml of the 10% fat emulsion provides 550 kcal.
500 ml of the 20% fat emulsion provides 1000 kcal.

D. Electrolytes, Vitamins and Trace Elements

(See section under Total Parenteral Nutrition

REFERENCES

Alpers DH, Clouse RE, Stenson WF.
Manual of Nutritional Therapeutics 1st Edition, Little, Brown and Company, Boston/Toronto, 1983.

Fischer J. E. Surgical Nutrition, 1st Edition,. Little Brown and Company, Boston/Toronto, 1983.

Grant JP, Handbook of Total Parenteral Nutrition, 1st Edition, W. B. Saunders Company 1980.

Long C., Metabolic Response to Nonseptic Stress, Clinical Consultations in Nutritional Support, 1983, 3(4).

Blackburn GL, Bistrian BR, Maini BS, et al. Nutritional and Metabolic Assessment of the Hospitalized Patient.1 JPEN 1977, 1(1); 11-22.

ENTERAL NUTRITIONAL SUPPORT

Enteral nutrition can be an effective feeding modality for the malnourished nutritionally depleted patient who is unable or unwilling to eat enough to repair or prevent nutritional deficiencies and who has a partially functioning gastrointestinal tract.

The first step in nutritional support, if the patient is capable of some intake, is the use of oral supplementation. However, in many cases, poor motivation or anorexia secondary to the disease state or treatment makes it difficult for the patient to meet his increased nutritional needs orally. For these patients, the use of a feeding tube may be indicated. Tube feeding can also be useful during the transitional period between parenteral to oral feeding. The type of product used depends upon the length and functional level of the gastrointestinal tract as well as the patient's disease state.

Enteral Products

Except the formulas designed for renal and hepatic failure, all commercially available enteral products will supply adequate vitamins and trace minerals to meet the requirement of normal persons when sufficient volume is supplied to meet the patient's protein and calorie requirements. Supplemental minerals and vitamins may be needed in patients with gastrointestinal losses, malabsorption, pre-existing deficiencies or increased requirements associated with their disease state.

Elemental Formulas

These products have minimal residue and are lactose-free. Their nutrients are provided in readily absorable forms (amino acids, di-and tripeptides, oligosaccharides, and safflower oil or medium chain triglycerides) requiring little or no digestion and may be suitable for patients with small intestinal, pancreatic or biliary tract disorders. Elemental products are hyprosmolar (450 - 800mOsm/L) and if given too rapidly will cause diarrhea. They should be started in dilute concentrations at a slow continuous drip rate or given orally. Administration by tube is recommended, however, because some patients find the taste unpleasant.

Complete Formulas

These formulas are low in residue and contain complex forms of carbohydrates, protein and fat. Therefore, digestion and absorption are required. The osmolarities of these formulas range from 300-600mOsm/L. All formulas available from Dietetic Service are lactose-free and contain 1-1.5 kcal/ml. The more concentrated formulas may be used for the fluid restricted patient as long as a provision for free water administration is made.

Special Formulas

Renal failure formulas are comprised mainly of essential amino acids, are essentially electrolyte free and contain inadequate vitamins. Their osmolarity is about 470mOsm/L.

Hepatic failure formulas have altered amino acid composition consisting of higher branched-chain amino acid content and lower aromatic amino acid content. Vitamin and mineral contents are variable, therefore, supplementation may be necessary.

Formula Selection

Appropriate formula selection is based upon several patient variables. Calorie/protein requirements, fluid/electrolyte balance, the feeding tube, site and small intestine digestive/absorptive function all must be considered.

Administration of Enteral Nutrition:

General Principles

- X-ray confirmation of proper placement prior to feeding initiation is essential.

- Continuous infusion of nutrients is preferable to bolus feeding. The use of an infusion pump is generally recommended, particularly when a hyperosmolar elemental diet is used or when feedings are infused into the small bowel.

Nasogastric/Gastrostomy Feedings

- When feeding is initiated slowly, the stomach can generally tolerate a relatively large volume without symptoms of dumping, cramps or diarrhea.

- Continuous infusion is recommended to lessen the chance of gastric distention, aspiration and diarrhea.

- Since the stomach is volume sensitive, it is suggested that volume be increased after the desired concentration is reached.

- When indicated, bolus feedings may be initiated after the desired rate and strength of continuous infusion is achieved and tolerated.

Jejunostomy and Other Small Bowel Tube Feedings

- Infusion of feedings via the jejunum lessens the change of fluid regurgitation with possible resultant aspiration.

- Since motility of the small bowel usually returns before gastric motility post-surgically, jejunal feedings may generally be initiated earlier than gastric ones.

- Because the small bowel is sensitive to high osmotic loads, it is recommended that the feeding volume be increased before the concentration is gradually increased.

- Bolus feedings are not recommended for small bowel tube feedings.

General Guidelines

- X-ray confirmation of proper tube placement prior to initiating a feeding is essential.

- Determine energy and protein needs based upon the nutritional assessment.

- Initiate feedings at half-strength (1/4 strength for elemental or 2 kcal/ml formula).

- Initiate rate of feeding at 50 ml/hour or less.

- Check for residual q 6 hours the first 24 hours after feeding is initiated.

- If the feeding is tolerated:

  gastrostomy: increase rate by 25 ml/hr every 12-24 hours until the desired rate is reached, then increase the concentration.

  small bowel tube: increase concentration by 1/4 increments every 12-24 hours, then increase the rate by 25 ml/hr every 12-24 hours until desired rate is reached.

- Elevate the head of the bed to 30 degrees - 45 degrees while the patient is receiving feedings; maintain this position for one hour after feeding.

Complications of Tube Feeding

1. DIARRHEA:

a. Causes:- Formulas are too concentrated or rate of infusion is too fast, *lactose intolerance, medications, contamination or fecal impaction.

b. Prevention: - Try continuous feeding instead of bolus feeding. Do not increase rate and concentration simultaneously. If any signs of intolerance occur after an advancement, return to the previous rate or strength and slowly advance rate or strength again.

*Commercial products available at this medical center are lactose-free.

- Do not attempt to catch up if feeding falls behind. Avoid infusing cold formulas.
- To avoid contamination, use clean technique during preparation, storage and administration of feedings. Refrigerate all air-exposed and prepared formulas and use within 24 hours.
- Diarrhea may be secondary to drug therapy; check the medications to determine if this may be the cause.
- Intestinal changes secondary to malnutrition or chemotherapy may cause diarrhea. Use an elemental formula or consider TPN until intestinal function returns.
- As a last resort, drugs such as lomotil, codeine, paregoric elixir, etc. may be effective.

2. DEHYDRATION:

a. Causes: - Inadequate administration of free water, increased need secondary to fever, prolonged diarrhea, fistulas, etc.

b. Prevention: - Administer additional free water (ex. 200-200ml of watger every 8 hours through the feeding tube.)

NOTE: Commercial formulas contain approximately 900 ml H_2O/1200ml of formula.

3. ASPIRATION:
- Elevate head of bed 30 degrees - 45 degrees whenever feeding is infusing
- Use continuous feeding
- Check for residuals

4. HYPERGLYCEMIA:
- Monitor electrolytes, blood glucose, and urine fractionals. Administer insulin as necessary.

5. FLUID OVERLOAD:
- Decrease administration of free water or use a calorie concentrated formula.

6. CLOGGED TUBING:
- Flush with 25-100ml of cola drink, cranberry juice or meat tenderizer (diluted with water).
- To avoid this problem, always flush tubing with 25-100ml of water before and after each feeding.

7. MONITORING PATIENTS:
- daily weights
- input/output record
- urine fractionals
- laboratory tests for electrolytes, hyperglycemia, etc. as needed based upon the patient's underlying disease.

Sample Formula Composition

Table VI

Formula	cal/.cc	Protein gm/l	Fat gm/l	CHO gm/l	NOPC: GN	mOSm/ Kg Water	Na/K mEq/l	Vitamins, cc to meet 100% U.S. RDA
Lactose Free								
Osmolite	1	37	39	145	153:1	300	24/26	1887
Ensure	1	37	37	145	153:1	450	37/40	1887
Ensure Plus	1.5	55	53	200	146:1	600	50/60	1600
Modified Enteral Formulas								
Criticare HN	1	38	3	222	148:1	650	37/34	1892
Vital HN	1	42	11	185	125:1	460	20/34	1500
Special Formulas								
Amin-Aid	2.0	19	46	366	838:1	560	15/6	----
Hepatic-Aid	1.1	44	36	169	148:1	1095	15/6	----
Modular Components								
Polycose	2	--	--	500	----	850	30/2	----
Pro-mix	4 cal/g	9g/ 11.8g Packet	--	---	----	---	7/41 per 100g	----

REFERENCES

Alpers DH, Clouse RE, Stenson WF.
Manual of Nutritional Therapeutics 1st Edition, Little, Brown and Company, Boston/Toronto, 1983.

Fischer J.E. Surgical Nutrition, 1st Edition, Little, Brown and Company, Boston/Toronto, 1983.

Grant JP, Handbook of Total Parenteral Nutrition, 1st Editio, W. B. Saunders Company 1980.

Long C., Metabolic Response to Nonseptic Stress, Clinical Consultations in Nutritional Support, 1983, 3(4).

Blackburn GL, Bistrian BR, Maini BS, et al. Nuitritional and Metabolic Assessment of the Hospitalized Patient.1 JPEN 1977, 1(1); 11-22.

PARENTERAL NUTRITION SUPPORT

A. Introduction and Ordering

1. The formulation of the solution will be tailored to fulfill each patient's daily fluid, caloric, protein, and electrolyte requirements for maintenance of basal metabolic rate plus activity, growth, and tissue repair. Vitamins and trace elements will be added to TPN solutions, usually in patients who are severly malnourished or in patients who require prolonged parenteral nutrition (2 weeks).

2. Fluids for any losses due to drainage tubes, nasrgastric suction, etc. should be considered and replaced.

Table VII

mEq/L

	Na	K	H	CL	HCO3
Sweat	30-50	5	-	45-55	-
Gastric	40-65	10	90	100-140	-
Pancreatic fistula	135-155	5	-	55-75	70-90
Bilary	135-155	5	-	80-110	35-50
Ileostomy	120-130	10	-	50-60	50-70
Diarrhea	25-50	35-60	-	20-40	30-45

3. Orders will be initiated after appropriate preliminary preparations have been made (See appendix 1) and will be written on the standardized parenteral nutrition "Doctors Order" form. (See Appendix 2). They will include the following information:

   a. Composition of basic nutritional solutions to be prepared.
   b. Additives, if needed, i.e., insulin, vitamins, cimetidine.
   c. Name of patient
   d. Ward of patient
   e. Date
   f. The anticipated rate of infusion of the nutritional solution over the ensuing 24 hours.
   g. The physician's signature; medical students' orders must be co-signed before orders will be fulfilled.
   h. Unsigned orders will be returned to the ward unprocessed.
   i. All orders will be prepared for a period not to exceed 48 hours.
   j. No new TPN orders will be accepted on weekends or holidays. Renewal orders written on Saturdays, Sundays and holidays must be received before noon or the previous days' TPN solution will be dispensed.
   k. Physicians are urged to obtain laboratory information prior to ordering TPN. Changes made in orders after noon (12:00) may not be honored until the following day.

4. Preparing of Solutions

   a. The pharmacist screens all orders for changes from the previous days' orders, incompatabilities, overdoses, etc.
   b. The pharmacist or technician aseptically prepares the basic solutions in the laminar flow hood.

c. Every solution container is clearly labeled with the patient's name, ward, physician's name, number of bottle, date of preparation, expiration date, rate, composition and additives.

d. Surveillance of prepared solutions for potential microbial contamination and particulate material will be established according to guidelines established by the Pharmacy Infection Control Committee.

e. The pharmacist thoroughly checks all solutions after preparation.

5. The first bottle of TPN will not be dispensed by the pharmacy until placement of the cathether has been verified by X-ray and this verification is documented in the patient's chart. (Appendix 1).

B. Solution Component Availability

The pharmacy has the capabilities to individualize parenteral nutrition solutions tailored to the needs of each patient. In addition, standard amino acid-electrolyte solutions are available.

1. Dextrose Solutions

a. For peripheral hyperalimentation, it is recommended that the final dextrose concentration not exceed 10% due to increased incidence of phlebitis at higher concentrations.

b. For central hyperalimentation, it is recommended that the final dextrose concentratrion not exceed 25%. Final dextrose concentrations of 35% should be reserved for patients who require strict fluid restriction (i.e., patients with renal failure or congestive heart failure).

c. One gram of dextrose supplies 3.4 k calories. Therefore a liter of dextrose 35% will provide 1190 k calories, dextrose 25% provides 850 k calories, dextrose 10% provides 340 k calories, and dextrose 5% provides 170 k calories.

2. Amino Acid Solution

a. General Crystalline Amino Acid Solutions

Crystalline amino acids are indicated in the treatment of negative nitrogen balance in patients with normal renal and hepatic function. Daily nitrogen requirements range 6 - 18 g/d. For the appropriate utilization of nitrogen, it is recommended that the non protein calorie to nitrogen ratio range from 150:1-200:1, with 150:1 being the most accepted ratio. In specific conditions such as sepsis, trauma, renal failure, or hepatic failure, either higher or lower ratios are favored.

TABLE VIII

CHART FOR HYPERALIMENTATION SOLUTIONS ORDERED IN GRAMS

MEDICAL CENTER STANDARD SOLUTIONS

*Final volumes are 1ℓ unless otherwise stated

ORDERS		Volumes Needed to Compound					Final Concentration		
Dextrose	Travesol (CAA)	$D_{10}W$	Travesol 10%	Water	Kcal/ml	Comments	Dextrose	Travesol	HPC:N Ratio
100 gm	27.5 gm	145 ml	275 ml	580 ml	.45	Usually given with 10% lipids	10%	2.75%	73:1
233 gm	67 gm	333 ml	667 ml	0	1.06	1	23.3%	6.7%	71:1
250 gm	42.5 gm	357 ml	425 ml	218 ml	1.02	Considered adequate for most patient's needs - "standard"	25%	4.25%	119:1
350gm	27.5 gm	500 ml	275 ml	225 ml	1.30		35%	2.75%	257:1
350 gm	42.5 gm	500 ml	425 ml	75 ml	1.36		35%	4.25%	166:1
350 gm	13.5 gm	500 ml	150 ml	100 ml	1.24	Final volume 750 ml	46.5%	1.8%	524:1
465 gm	28 gm	665 ml	285 ml	50 ml	1.69		46.5%	2.8%	342:1

1) crystalline amino acid solutions 10%,

contains - Acetate 87 meq/L
Chloride 40 meq/L

2) crystalline amino acid - electrolyte solutions 8.5% and 5.5%

	5.5% meq/L	8.5% meq/L
contains - Sodium	70	70
Potassium	60	60
Magnesium	10	10
Acetate	135	100
Chloride	70	70
Phosphate (as HPO_4+)	60	60

Baseline electrolyte requirements in patients with normal renal and hepatic function

Electrolyte	Normal Range
Sodium	2 meq/kg/d (50-250)
Potassium	1.25 meq/kg/d (30-200 meq)
Magnesium	0.15 meq/kg/d (10-30 meq)
Calcium	5-20 meq/d
Phosphate	20m moles/1000 calories (10-40 m mole)

Na phosphate 4.0 meq = 3 m moles PO_4=
K phosphate 4.4 meq = 3m moles PO_4=

Patients with renal failure should not receive supplemental magnesium unless they have a documented magnesium deficiency. In patients with renal failure, phosphate requirements are also altered, so serum calcium and phosphate levels must be closely monitored.

b. Specialty Amino Acid Solutions

1. Essential amino acid solution

Essential amino acid solutions are indicated as an adjunct to offset nitrogen loss or in the treatment of negative nitrogen balance in potentially reversible renal decompensation. Patients with chronic renal failure or patients with acute renal failure who are being dialyzed require essential, branched-chain, and non essential amino acids. Therefore, general crystalline amino acid solutions should be used. In patients with renal failure, the non protein calorie: nitrogen ratio may be increased to 350:1 - 800:1 depending upon the patient's ability to utilize protein for anabolism and the frequency of dialysis.

2. High branched chain amio acid (BCAA) solutions

a) Hepatic formulations

Hepatamine is a 35% BCAA formulation indicated in the treatment of hepatic encephalopathy in patients with cirrhosis or hepatitis. It is also used in the nutritional support of patients with liver diseases who require parenteral nutrition and are intolerant to general crystalline amino acid solutions. The rationale for the use of a high BCAA solution is based upon observations of plasma amino acid imbalances in patients with liver disease and on theories which postulate that these abnormal patterns may be casually related to the development of hepatic encephalopathy.

Patients with stable liver disease may be given TPN with general crystalline amio acid solutions. The total amount administered should be limited to 40 - 50 g per day which will meet basal nitrogen requirements.

b) Trauma and sepsis formulations

Research is currently being performed using 45 - 55% BCAA with varying specific BCAA ratios. It is thought that specific ratios of valine and leucine may be required for maximum utilization of nitrogen for anabolism. Although with further research these high BCAA solutions may prove beneficial in septic and trauma patients, their use at this time cannot be supported based upon current clinical findings.

3. Intravenous lipid (fat) emulsions 10% and 20% - 500 cc.

Fat emulsions made from soybean or safflower oil are indicated as both a source of calories and a source of essential fatty acids in patients requiring parenteral nutrition. Essential fatty acid deficiency syndrome will be prevented or corrected and reversed when 8 - 10% of the total non-protein calories are provided by a fat emulsion. When used as a source of calories, fat emulsions should not provide more than 60% of a patient's total caloric intake. The infused lipid particles resemble chylomicrons and are removed from the blood stream through the same enzymatic clearance pathways.

Fat emulsions are contraindicated in patients with abnormal fat metabolism such as pathologic hyperlipidemia, lipoid nephrosis, and acute pancreatitis if accompanied by hyperlipidemia. Fat emulsions should be used with caution in patients with severe liver damage, neonates with pulmonary diseases, anemia, or blood coagulation disorders where there is a danger of fat embolism.

A 500 cc dose of a 10% fat emulsion will provide 550 k calories while 500 cc of a 20% solution will provide 1000 k calories.

Adverse reactions resulting from the administration of fat emulsions are rare but may include acute hypersensitivity reactions, hyperlipidemia, nausea, vomiting, hyperthermia, thrombocytopenia (rarely, in neonates), hypercoagulability, and irritation at the injection site. Chronic reactions with long term therapy have included hepatomegly, cholestasis, splenomegaly, thrombocytopenia, transient elevations in liver enzymes, brown pigmentation of liver tissue, and "overloading syndrome" (characterized by focal seizures, fever, leukocytosis, splenomegaly, and shock).

Because lipid emulsions are isotonic, coadministration with base TPN solutions will reduce the overall osmolarity of infused fluids, making them advantageous in peripherpal vein hyperalimentation.

4. Vitamins, minerals, and trace elements

The American Medical Association/Nutrition Advisory Group Guidelines recommend the following parenteral vitamin supplementation in patients on hyperalimentation. These amounts are contained in each 10 ml. dose of MVC 9 + 3.

Vitamin	Daily Dose
A	3300.0 TU
B_1 (Thiamine)	3.0 mg
B_2 (Riboflavin)	3.6 mg
B_3 (Pantuthenic Acid)	15.0 mg
B_5 (Niacin)	40.0 mg
B_6 (Pyridoxine)	4.0 mg
B_7 (Biotin)	60.0 mg
B_9 (Folic Acid)	400.0 mcg
B_{12} (Cobalamin)	5.0 mcg
C (Ascorbic Acid)	100.0 mg
D	200.0 TU
E	10.0 TU

In addition, all patients except those with splenomegaly should receive vitamin K 5 - 10 mg weekly (administer every Friday). Folic acid and thiamine are included in MVC 9+3 and B12 should be administered monthly.

Suggested daily intravenous supplementation of essential trace elements include:

Element	Daily Requirement	Adult in Acute Catabolic State	Stable Adult With Intestinal Losses
Zinc	2.5-4.0 mg	Additional 12 mg	12.1 mg/L small bowel fluid lost 17.1 mg/kg stool (ileostomy output)
Cooper	0.5-2.5 mg	--	--
Chromium	10-15 mcg	--	20 mcg
Manganese	0.15-0.8 mg	--	

Iron in the form of iron dextran or blood transfusions may be required in patients on hyperalimentation for extended periods of time. It is generally recommended that these patients receive 100 mg monthly or bimonthly. 2cc iron dextran (100 mg) can be added daily to the hyperalimentation regime in patients at risk of iron deficiency anemia, but its routine use is discouraged.

5. Drugs

a) Heparin

Heparin in low dosages (1000 TU/bottle) has been advocated to prevent clotting in the IV line with hyperalimentation solutions. It has also been found that heparin stimulates enzymatic clearance pathways for fat emulsions.

b) Insulin

Most patients are able to metabolize the glucose load of parenteral nutrition solutions with endogenous insulin if instituted at a proper rate. It is not uncommon for patients to have mild glycosuria (1-2 plus or 1/2 - 3/4%) during the initiation of therapy. This is not a definite indication for insulin therapy as the patient will adjust to the glucose load within 2 - 3 days. If the patient

demonstrates a lower tolerance for the glucose load (i.e. diabetic patients), regular insulin can be added directly to the hyperalimentation solution based on blood sugars. Insulin may be co-administered on a sliding scale, but this is only occasionally necessary. Usually it is recommended that therapy be initiated with 10 units per bottle and adjusted based upon response (refer to section on complications).

c) Cimetidine

Cimetidine can be added to hyperalimentation solutions in patients who are candidates for cimetidine therapy, and will avoid the need for separate intravenous infusion of this drug.

Addition of drugs to the hyperalimentation solution is not routinely recommended.

C. **Administration:** See nursing sections on Insertion and Maintenance of CVP line.

COMPLICATIONS: POSSIBLE CAUSES AND ACTIONS FOR CORRECTION

I. Technical Complications

Catheter insertion/maintenance

1. Pneumothorax

   a. Cause: Multiple punctures, failure to remove patient from respirator, "slow leak", improper technique

   b. Signs and symptoms: Patient may exhibit symptoms of dyspnea, chest pain, and/or cyanosis

   c. Action: notify ward physician
   obtain chest X-ray
   observation if small
   chest tube if large or progressive

2. Malposition

   a. Cause: anatomy of patient, needle passed through vein

   b. Signs and Symptoms: pain or tingling in ear or neck area on side of insertion
   no free reflux of blood
   none

   c. Action: reposition with guidewire or fluoroscopy
   new puncture
   catheter removal

3. Subclavian Artery Puncture

   a. Cause: incorrect insertion

   b. Signs and Symptoms: return of bright red blood under high pressure, hematoma

   c. Action: remove needle
   elevate head of bed
   apply pressure to puncture site
   observe patient closely

4. Carotid Artery Puncture

   a. Cause: internal jugular catheterization

   b. Signs and Symptoms: hematoma, tracheal obstruction

   c. Action: local application of direct pressure

5. Catheter Embolism

   a. Cause: shearing off section of catheter (i.e. when pulling catheter back through needle)

   b. Signs and Symptoms: cardiac irritability

   c. Action: radiological or surgical removal

6. Air Embolism

   a. Cause: injection of air during catheter threading
   tubing disconnection

   b. Signs and Symptoms: dyspnea, chest pain, tachycardia, tachypnea, cyanosis, paresis, cardiac arrest.

   c. Action: place patient left side down in steep trendelenberg position
   needle aspiration of heart

7. Thrombosis/Clotting of Catheter

   a. Cause: mechanical irritation,
   hypercoagulable state in patient

   b. Signs and Symptoms: distended collateral veins and chest wall
   acute unilateral edema of arm, neck, and face, pleuritic chest pain
   inability to thread catheter

   c. Action: call ward physician/nurse clinician immediately
   irrigation of the catheter may be necessary
   pulling of the catheter and re-establishment of a new line may be necessary
   trial of streptokinase may be indicated
   in the event of embolism of a clot, the catheter may need to be removed, a venogram performed, and the patient put on heparin therapy

8. Blood Backing Up In Line Or Leaking Around Dressing

   a. Cause: disconnection of tubing from catheter
   leakage at tubing junction points or insertion site
   malfunction of pump (stopped, slow rate)
   bottle empty
   patient malposition

   b. Signs and Symptoms: wet saturated dressing
   blood leaking from insertion site or from under dressing
   shortness of breath

   c. Action: check tubing for kinks
   if breakage has occurred, notify house officer or nurse clinician

9. Break in Catheter/Removal of Catheter

   a. Cause: kinking at junction of IV tubing
   improper looping of dressing/improper taping or suturing unrestrained careless moving of patient or equipment

   b. Action: properly restrain patient
   redress catheter wound site - call ward physician if resuturing is necessary
   X-ray to check catheter positioning
   if catheter has been pulled out completely, notify ward physician immediately, apply pressure to site for 5 minutes
   start IV of D10W as soon as possible
   monitor patient for signs and symptoms of hypoglycemia

10. Precipitate Formation

   a. Cause: improper additions of any medication into the solution

   b. Signs and Symptoms: cloudy solution

   c. Action: check all solutions for precipitate before hanging

ii. TPN Running At Improper Rate

a. Cause: improper pump rate setting or malfunctioning of the pump
kinking in the tubing or catheter
malpositioning of the patient pinching off flow

b. Signs and Symptoms: hypoglycemia, glycosuria, blood backing up in tubing

c. Action: periodically check (q 1 hour) to see if TPN is running at the proper rate
check pump for correct flow settings
check pump accuracy against a set time (drops per minute)
reposition patient and possibly use restraints upon physician order if the patient interferes with the line
check tubing for leaks, twist connections tight, and replace tubing if necessary, tape all connection sites

II. Septic Complications

a. Causes

Failure to adhere to strict aseptic technique during catheter insertion, dressing care and maintenance or solution preparation; immunosuppressed patient.

b. Signs and Symptoms

1. excessive or sudden appearance of glucose in urine

2. sudden elevation in blood glucose

3. redness and drainage, pus, or pain at catheter site

4. lethargy, restlessness, disorientation observed

5. spiking temperatures above 101 degrees Fahrenheit

6. elevated white blood cell count

7. hypotension

c. Action

1. notify ward physician and stop TPN solution immediately - hang D10W with new tubing through central line.

2. inspect catheter site, looking for erythema and pus.

3. remove catheter and send the following to lab:

   a. culture of insertion site

   b. culture of catheter tip

   c. culture of TPN solution and tubing

   d. wait 12 - 24 hours before re-insertion of another catheter

      If temperature declines within 12 - 24 hours following cessation of TPN solution, the solution or the tubing are implicated as the source of infection.

   e. culture of draining wounds

   f. blood cultures

   g. urine cultures

4. chest X-ray

5. antimicrobial therapy if indicated

III. Metabolic Complications

A. Glucose Abnormalities

1. Hyperosmotic, nonketotic, hyperglycemic dehydration

   (a) Causes: excessive total amount of glucose or rate of infusion (the usual capacity for glucose metabolism is 4 - 6 mg/kg/min rate should be titrated as the pancreas becomes accustomed to the large glucose load).
   inadequate endogenous insulin (exogenous insulin may be necessary to keep glucose <200 mg/dl)
   increased potassium requirements

   (b) Signs and Symptoms: elevated blood glucose (500-1000 + mg/dl) glycosuria, osmotic diuresis, metabolic imbalances, lethargy, coma, death

(c) Action: repeat lab assessment
check administration rate (NEVER INCREASE INFUSION RATE 5% TO CATCH UP ON SOLUTIONS)
determine serum potassium/urinary potassium. Titrate urinary potassium until it reaches 25-35mEg/l in patients with normal renal function stop hypertonic solution
hydrate with free water
judicious doses of insulin and potassium
close laboratory and patient monitoring

2. Hypoglycemia

(a) Causes: Persistence of endogenous insulin production secondary to prolonged stimulation of islet cells by high carbohydrate infusion. Occurs when TPN is stopped abruptly without attempting to gradually taper infusion rate to zero, (DO NOT INTERRUPT TPN FOR THE INFUSION OF OTHER FLUIDS, I.E.: BLOOD, FAT EMULSIONS, ALBUMIN, ETC.) If the patient requires surgery, glucose containing solutions (D5W, D10W) can be substituted at the same rate as the TPN). Mechanical problems

(b) Signs and Symptoms: blood glucose range of 40 mg/dl or less lethargy or coma

(c) Action: bolus dextrose infusion
monitor blood glucose
if discontinuing TPN, gradually decrease the rate of infusion over a 24-48 hour period, OR give adequate oral caloric intake prior to stopping TPN, OR administer less hypertonic glucose solutions (D5W, D10W) for at least 6 hours after stopping TPN.

B. Amino Acid Metabolism

1. Hyperchloremic Acidosis

(a) Causes: Excessive chloride administration

has been observed with crystalline amino acids when infusion rates resulted in the administration of 4gm/kg/day. Normal serum pH and base excess were established when rates were decreased to 2gm/kg/day.

(b) Signs and Symptoms: elevated serum chloride; elevated serum potassium

(c) Action: Avoid high chloride loads when meeting daily electrolyte requirements of Na and K+ by using acetate salts. Do not add bicarbonate to TPN. Insoluble carbonate salts (Ca, Mg) may precipitate from the solution and CO_2 gas may evolve.
Decrease the rate of infusion.

2. Hyperammonemia

(a) Causes: Excessive ammonia administration: In the past, protein hydrolysates with large amounts of free ammonia have been the largest offenders.

An arginine, ornithine, aspartic acid and/or glutamic acid deficiency in amino acid solution.

Primary hepatic disorder.

Hyperammonemia occurring with crystalline amino acids appears to be associated with duration of therapy. More likely to occur after 2 - 3 weeks of administration.

(b) Action: Stop infusion of nitrogen source and switch to dextrose with electrolytes. When blood NH returns to normal, restart nitrogen source but at lower rate or stength and titrate using blood ammonia levels.

3. Prerenal Azotemia

(a) Causes: Excessive total dose or rate of amino acid infusion.
Insufficient non-protein calories supplied; the protein source is being used for calories rather than protein synthesis.

(b Action: Check rate of infusion and check amount (grams) of amino acids per kilogram per day
Insure that sufficient calories are being administered.

c. Electrolyte and Mineral Metabolism

1. Hypokalemia

(a) Causes: Inadequate potassium intake in presence of increased requirements for protein synthesis.

Magnesium deficiency. In the presence of Mg deficiency, hypokalemia may be refractory to K+ supplementation.

Excessive gastrointestinal loss, alkalosis

(b) Signs and Symptoms: low serum potassium, cardiac arrhythmias, muscle weakness, impaired respiratory function

(c) Action: Increase amounts of K+ supplementation. (Large requirements are associated with prolonged hypertonic glucose infusions and increased demands of anabolism).
See that magnesium requirements are being met
Monitor serum potassium
Check acid/base status

2. Hyperkalemia

(a) Causes: Inability to utilize administered potassium
decreased renal function
systemic sepsis
acidosis
low cardiac output

(b) Signs and Symptoms: elevated serum potassium, cardiac arrhythmias, bounding or diminishing pulses

(c) Action: stop infusion
change to low potassium solution
monitor serum potassium levels
check acid/base status

3. Hypophosphatemia

(a) Causes: Inadequate phosphorus administration
redistribution of serum phosphorus into cells and/or bone
excessive use of phosphate binders (ALOH)
increased demand during anabolism

(b) Signs and Symptoms: lethargy, altered speech, peripheral paresthesias, increased respirations, muscle weakness, coma, low serum phosphate

(c) Action: Increase phosphate supplementation. (Calcium must be added simultaneously to prevent drop in serum CA++ leading to hypocalcemic tetany). In severe hypophosphatemia, the replenishment of depleted body stores is slow and may take up to 2 weeks. Red cell survival usually improves rapidly following 2 - 3 days of normal serum phosphate levels.

4. Hypocalcemia

(a) Causes: Inadequate calcium administration
Phosphate supple mentation without simultaneous calcium infusion.
Magnesium deficiency.
Hypoalbuminemia.

(b) Signs and Symptoms: Paresthesia, postive chvostek's sign, low serum calcium.

(c) Action: Calcium supplementation. (It is important to provide adequate levels of Ca for maintenance of bone mineralization without inducing soft tissue calcifications. Adequate intake of vitamin D should be maintained)
Check serum albumin level

5. Hypomagnesemia

(a) Causes: Inadequate magnesium supplementation. Mg activates all enzymes transferring phosphate to and from ATP and ADP. Mg also plays a role in regulating neuromuscular irritability.

(b) Signs and Symptoms: Tingling sensation around mouth, paresthesias, dizziness, disorientation
low serum magnesium

(c) Action: Addition of magnesium to TPN solution
Monitor serum magnesium

6. Anemia

(a) Causes: Iron deficiency
folic acid deficiency
Vitamin B12 deficiency
Phosphate deficiency
Magnesium deficiency
Copper deficiency.

(b) Signs and Symptoms: pallor, fatigue, listlessness, exertional dyspnea, headache, paresthesias

(c) Action: Iron supplementation IV or PO as indicated by periodic hemoglobin, TIBC, transferrin reports.
Folic acid and B12 according to requirements
Monitor serum phosphate and magnesium levels

7. Vitamin K Deficiency

(a) Causes: deficient oral intake
severe diarrhea
obstructive jaundice
prolonged antibiotic therapy

(b) Signs and Symptoms: elevated coagulation tests, hematuria, ecchymoses, bleeding, purpura

(c) Action: weekly IM injection of Vitamin K (may also be added to TPN solution)
monitor PT/PTT

8. Zinc Deficiency

(a) Causes: inadequate PO/IV intake
chronic illness
excessive gastrointestinal losses

(b) Signs and Symptoms: diarrhea, CNS disturbances, skin lesions (resemble fungal infection), poor wound healing, alopecia, anorexia, growth retardation

(c) Treatment; Addition of zinc to solutions

9. Hepatic Dysfunction

(a) Causes: factors associated with TPN administration promote the accumulation hepatic fat. Fat deposition in the liver has been associated with intra-hepatic cholestasis and elevated liver function tests. The cause(s) of hepatic dysfunction is unknown, however, the infusion of large amounts of carbohydrate as fat-free TPN has been implicated as well as exaggerated caloric doses.

(b) Action: Possible use of "cyclic" TPN: that is, to omit the glucose in one of the TPN bottles each day. This should be done very carefully with the rate slowly tapered over one to two hours before administering glucose-free TPN. Likewise, the next TPN bottle containing glucose should be started slowly and tapered up to the maintenance rate. The patient should be carefully monitored for hypo and hyper glycemia during the tapering periods. Glucose concentrations also may be decreased and fatty acid requirements should be met.

REFERENCES

TOTAL PARENTERAL NUTRITIONAL REVIEWS

1. Alpers DH, Clouse RE, Stinson WF, Manual of Nutritional Therapeutics, Little, Brown and Co. Boston 1983

2. Clemmer TRP, Orme JR. Nutritional Support in the Adult Respiratory Distress Syndrome. Clin Chest Med., 1982;3, 1:101

3. Fischer J.D. Total Parenteral Nutrition, Little, Brown and Co. Boston 1983

4. Grant JP Handbook of Parenteral Nutrition, WB Saunders Co, Philadelphia 1978

5. Jeejeebhoy KN, Baker JP, "Parenteral Nutrition" in RG Petersdorf, et al (eds) Harrison's Principles of Internal Medicine, Tenth Ed. McGraw Hill, St. Louis, 1983.

6. Kudsk KA, Mirtallo JM. Nutritional Support of the Critically Ill Patient, Drug Intell Clin Pharm 1983; 17:501

7. Parrish G, Gibney A, Ethel L. Total Parenteral Nutrition - An Update. Nutritional Suppt Serv. 1982, 2, 3:9

8. Phillips G D, Odgers CL. Parenteral Nutrition: Current Status and Concepts, Drugs 1982; 23:276

9. Shils ME. Principles of Nutritional Therapy, Cancer 1979; 43:2093

PERIPHERAL HYPERALIMENTATION

1. Deitel M. Kaminsky V. Total nutrition by Peripheral Vein - The Lipid System. Can Med Assoc J. 1974, 111:152

2. Fong WL, Grimly GW. Peripheral Intravenous Infusions of Amino Acids, Am J Hosp Pharm. 1981; 38:652

3. Watters J M, Freeman JB. Parenteral Nutrition by Peripheral Vein Surg Clin N. Am. 1981; 61, 3:593

TOTAL PARENTERAL NUTRITION IN LIVER DISEASE

1. Barber JR, Teasley K. Nutritional Support of Patients with Severe Hepatic Failure. Clin Pharm 1984; 3,3:245.

2. Cerra FB, McMillen M, Angelico R, et al. Cirrhosis, Encephalopathy, and Improved Results with Metabolic Support. Surgery. 1983; 94,4:612.

3. Fischer JE, Bower RH. Nutrition Support in Liver Disease. Surg Clin N Am. 1981; 61, 3:653.

4. Freund H, Drenstaf J. Lehrich J. Infusion of a Branched Chain Amino Acid Solution in Patients with Hepatic Encephalopathy, Am Surg 1982; 196, 2:209

Total Parenteral Nutrition in Renal Failure

1. Kopple JD. Nutritional Therapy in Kidney Failure. Nutritional in Kidney Failure. Nutritional Reviews 1981;39 5:193

2. Mirtallo JM, Kudak KA, Ebbert ML. Nutritional Support of Patients With Renal Disease. Clin Pharm 1984; 3,3:253.

3. Mirtallo JM, Schneider PJ, Havko K et al. A Comparison of Essential and General Amino Acid Infusions in the Nutritional Support of Patients with Compromised Renal Function. JPEN. 1982; 6,2:109.

4. Steffee WP. Nutritional Support In Renal Failure. Surg Clin N. Am 1981; 61,3:661.

Total Parenteral Nutrition In Sepsis

1. Askanazi J., Carpenter YA, Elwyn DH et al. Influence of Total Parenteral Nutrition on Fuel Utilization in Injury and Sepsis Ann Surg. 1980, 191,1:40.

2. Giovannini L, Boldrini G. Castagneto M. Respiratory Quotent and Patterns of Substiate Utilization in Human Sepsis and Trauma. JPEN. 1983; 7,3:226.

Fat Emulsions

1. Bruins B, Bele R, Rapp R, Griffin W. Linoleic Acid Versus Linolenic Acid: What is Essential? JPEN. 1982 7,5:473.

2. Nordenstrom J, Carpenter U, Askanai J. Metabolic Utilization of Intravenous Fat Emulsion During Total Parenteral Nutrition. Ann Surg 1982; 196,2:221.

3. Pelham LD. Rational Use of Intravenous Fat Emulsions. Am J. Hosp Pharm. 1981; 38:198

4. Silverman H. Freehauf M, Fong G, Rosenblatt N J, Am Med Assoc. 1977; 238,13:1380

Trace Elements

1. Anon. Guidelines for Essential Trace Element Preparations for Parenteral Use. A statement by an Expert Panel. J. Am. Med Assoc 1979; 241,19:2051.

2. Hull RL, Cassidy D. Trace Element Deficiencies During Total Parenteral Nutrition. Drug Intell Clin Pharm. 1977; 11:536.

3. Odne ML, Lee SC, Jeffrey LP. Rationale for Adding Trace Elements to Total Parenteral Nutrition Solutions. Am J Hosp Pharm.1978; 35:1057.

NURSING CARE OF THE NUTRITIONALLY COMPROMISED PATIENT

INTRODUCTION

The initial nursing admission history is one of the most important factors in determining when a patient is at nutritional risk. Poor nutritional status increases the risks of morbidity and mortality. The sooner the patient at risk is identified, the sooner adequate intervention can be initiated to prevent, or at least minimize, the severe effects of malnutrition.

The initial nursing history should include:

- Height and weight - each patient should be weighed on admission without shoes (also document amputations) a gain or loss of 10% of body weight within the past six months without effort should be documented.
- Typical daily food consumption (this should include types of food eaten, where the patient eats, who does the cooking, etc.)
- Food allergies or intolerances
- Any modified diet that the patient instructed to follow and whether or not he complies.
- History of cigarette smoking and alcohol consumption (packs/day, type of alcohol consumed and frequency)
- Any prolonged (>7 days) alimentary tract dysfunction (anorexia, difficulty chewing, dysphagia, nauses, vomiting, diarrhea, chronic constipation, bloody, tarry, muccid or other unusual stools.)
- Prescribed or over-the-counter medications (include those prescribed to which patient is noncompliant) and allergies
- Existing chronic diseases (hepatic or renal failure, pancreatitis, enteritis, colitis, fistulas, malignancies, diabetes, etc.)
- Previous surgeries and any complications encountered

During the interview process, the nurse should observe the patient's general appearance. Any of the following may be observed and should be documented in the admission nursing note:

- General appearance (obesity, cachexia, edema, abdominal distention, generalized dehydration, listlessness, lack of energy, decubiti, etc.)
- Appearance of hair (may lack luster, appear dry, hair loss anywhere on the body, change in character)
- Skin (dry, scaly, lacks turgor, dermatitis, rash, petechiae, purpura or generalized change in color)
- Eyes (may appear "sunken" or lack sparkle, eyelids may be reddened.)
- Bony prominences of the head may be evident
- The lips and tongue may be dry, discolored, scaly or coated
- The nails may be brittle
- Generalized muscle weakness and wasting may be apparent and there may be pain in calves or joints.
- There may be confusion, disorientation or coma.

Abnormal results of the initial nursing history should be communicated to the ward physician. In addition, the ward dietitian should be notified of all new admissions so that a more thorough nutritional assessment and nutritional plan can be initiated. The Nutritional Support Team's dietitian will also assess and follow all patients on enteral and parenteral nutritional support and is available for consultation by the staff.

The patient's nutritional status should be periodically reevaluated during hospitalization and any changes due to deteriorating condition or prolonged periods of fasting or test meals should be documented and reported. As with all areas of patient care, nutritional support is a collaborative effort and consultation of the Nutritional Support Team for intervention in nutritional deficiency that may require enteral or parenteral support should be encouraged.

ENTERAL NUTRITION

Enteral nutrition support or tube feedings are indicated in patients who have a functional alimentary tract, but for reasons of anorexia, dysphagia or a functional disorder are unable to consume and/or retain sufficient calories to maintain adequate nutrition. This route is the preferred route for nutritional support and maintenance in all cases where the GI tract is functional. This route also has less complications associated with it as compared to the parenteral route; it can be used in cases where total or supplementary nutritional support is indicated.

I. Types of Feeding Tubes

A. Intermittent or Continuous Feeding

1. Nasogastric tubes - These can be #16 Fr. or #18 Fr. Salem sump tubes or #16 Fr. or #18 Fr. red rubber catheters. They are frequently inserted after head and neck surgery and are used when long-term therapy may not be indicated or in cases where the patient will be discharged home with the tube in place and be required to use the tube for nutritional support at home. These tubes can be easily inserted at the patient's bedside.

2. Gastrostomy tubes. These tubes are inserted in the OR under local anesthesia or in the GI lab (by endoscopic gastroscope). They are usually some form of foley catheter (#16 Fr. or #18 Fr.) or a Pezzar catheter and are frequently used when there is an obstruction in the upper GI tract. These tubes also lend themselves to home care.

ADVANTAGES

Both of these tubes allow the patient to administer his own feedings and thus they can be used at home. Because of their larger size, there is also less chance of them becoming plugged from the administration of crushed medications or the use of a thicker consistency tube feeding such as a pureed diet. Their placement in the GI tract also allows for bolus feedings when gastric emptying is normal. There are also less cases of diarrhea with this type of tube feeding regimen.

DISADVANTAGES

The nasogastric tube is uncomfortable and may be a source of embarrassment to the patient because it is so obvious. Irritation to the mucous membranes can also cause necrosis, esophagitis or strictures. Both can make the patient more prone to aspiration and gastric retention if gastric emptying is impaired. The gastrostomy insertion site requires daily cleansing and dressing to prevent infection. This tube can also, over time, become dislodged, requiring reinsertion by medical personnel as soon as possible.

B. Continuous Feeding

1. Nasoduodenal tubes - These tubes are #8 - 14 Fr., small bore tubes (Dobbhoff). They have a weighted tip that allows passage into the duodenum, thus decreasing the risk of aspiration. These tubes are recommended for long term feeding as they are less irritating than nasogastric tubes.

2. Jejunostomy tubes - These tubes are generally some form of Foley tube, #14 - 16 Fr. Their insertion is done surgically by general anesthesia. Their placement is considered more or less permanent.

ADVANTAGES

Both of these tubes minimize the risk of aspiration. They can be used for long-term, continuous nutritional support. The nasoduodenal tube is soft and less irritating and more comfortable for the patient. The weighted tip allows easy passage into the small intestine.

DISADVANTAGES

Because these tubes are in the duodenum or jejunum, diarrhea is common with both. The smaller lumen of these tubes can easily clog with the introduction of thick formulas or crushed medication. The jejunostomy tube insertion site requires daily cleansing and dressing changes to prevent infection; it can also become dislodged and may require prompt reinsertion.

II. Tube Insertion

Generally, these tubes are inserted by the physician. Placement should be confirmed by abdominal x-ray, air instilled into the stomach and heard through a stethoscope placed over the abdominal area, or by aspiration of stomach contents prior to feeding. Radiological confirmation should be documented in the progress notes by the physician prior to the initiation of feeding and the tube should be securely anchored with tape.

III. Feeding Administration

The physician, in collaboration with the Nutritional Support Team's dietitian will determine the caloric requirements for each patient and the strength of the formula to be used. Feedings should begin upon the written order of the physician.

A. General Considerations - Intermittent Feeding

1. The head of the bed should be elevated at least 30 degrees during feeding and for two hours afterwards. The patient should also be encouraged to sit up in a chair or ambulate, if able.

2. A new feeding bag and tubing should be given to the patient every 24 hours, preferably with the first feeding every morning. The bag should be rinsed thoroughly with tap water after each feeding.

3. Feedings should begin slowly. Use a low volume of 50 - 100 ml/3-4 hours of 1/2 strength solution or less depending upon the formula.

4. The tube should be aspirated before each subsequent feeding. If more than 1/2 of the previous feeding (or 50 ml, whichever is greater) is aspirated, then the feeding should be delayed one hour to provide for gastric emptying.

5. The feeding can be increased in increments of 50-100 ml with every one to two feedings until the maximum is reached (no more than 500 ml every 4 hours). Concentration can also be increased in a similar fashion until full strength is reached or to patient toleration.

6. Free water should also be given through the feeding tube. At least 100 ml every shift or after each bolus feeding is recommended.

7. When the patient appears ready, teach him to administer his own tube feedings: Then, he can feed himself as hunger develops and he may take on a feeding schedule that is similar to oral mealtimes.

B. General Consideratrions - Continuous Feedings

1. The head of the bed should be elevated 30 degrees at all times to prevent aspiration. If it is necessary to roll the patient down for any treatment, then the feeding should be temporarily discontinued and resumed when the treatment is over and the head of the bed is again at 30 degrees.

2. The feeding should be initiated slowly, 25-50 ml/hour initially and increased every 12-24 hours by 25-50 ml/hour to a maximum of 100-150 ml/hour which may be reached within 3 days of initiation of enteral feeding if the patient tolerates it.

3. Depending upon the formulation, the concentration should be gradually increased from 1/4 strength to full strength or the maximum strength the patient tolerates without cramping or diarrhea. Isotonic solutions may sometimes be initiated at full strength.

4. The feeding bag and tubing should be changed every 24 hours, preferably with the first feeding every AM. The bag should be rinsed with tap water between additions of feedings.

5. Commercially prepared mixes (e.g. Ensure, Isocal, etc.) should hang no longer than 8 hours to prevent spoilage and bacterial growth. Each shift should prepare its own feeding to hang. For dietary prepared mixes (e.g. Hepatic Aid, Vivonex, etc.) only 4 hours worth of solution should be hung to decrease the chance of bacterial growth as the solution warms to room temperature.

6. An infusion device should be used to insure a constant rate of infusion, especially at the initial slow rates. As the patient nears discharge, the infusion device can be stopped and the rate adjusted manually. This will prepare the patient for discharge home or to an institution where infusion devices are not available.

7. Free water of at least 50 ml every 4 hours should be given to prevent dehydration and to keep the tube patent. The feeding tube should be aspirated prior to administration of free water and q 4 hours between feedings to check for residuals greater than 100 ml.

8. Administration of crushed medications through the feeding tube should be discouraged. Elixirs should be substituted whenever possible. KCl should never be added to the feeding as this will curdle commercially prepared formulas. KCl may be given through the tube via syringe, rinsing the tube with 20 ml water before and after administration.

IV. Monitoring the Patient

1. The patient should be weighed daily for the first 2 weeks of nutrition support and then 2 - 3 times weekly. This should be done every morning at 6:00 a.m. on the same scale each day. In the case of a comatose patient, a minimum of three times weekly is acceptable. The patient may be weighed once weekly if tube feedings are well tolerated.

2. Intake and output must be recorded every shift. Tube feeding, oral intake and IV intake should be recorded separately to allow monitoring of adequate intake for each category of fluid. Output from tubes, Foley catheters, liquid stool, etc. should be recorded in the same fashion.

3. Urine sugar and acetone (S&A) measurements should be done twice a day 6:00 a.m. and 6:00 p.m. with the results recorded on the appropriate form. If the patient is a diabetic, S&A should be done every 6 hours 5a-11a-5p-11p and the results recorded. One-half to 3/4 % is an acceptable level of glycosuria, but a greater percentage may require insulin coverage.

4. Vital signs should be taken every shift and a temperature of 101 or greater should be reported to the ward physician.

5. Mouth care should be given 3-4 times per day. Mouth wash and water should be used to alleviate mucosal dryness. Teeth should be brushed daily.

6. The continuous infusion device and the tube feeding bag should be checked every 1-2 hours to determine that the desired rate of administration corresponds to the volume actually delivered from the feeding bag. The rate should not be increased or decreased more than 5% (5-10 ml per hour) of the ordered rate in order to keep the infusion rate constant.

V. Dressing Changes

Gastrostomy and jejunostomy tube insertion sites must be cleansed and dressed daily. If the patient is able, he can be taught to do the procedure himself, as early as possible in his hospital course. If the patient is unable to do so, then a family member or significant other can be taught to do it.

The old dressing should be removed and inspected for the presence of pus or bleeding. The insertion site should also be inspected for excessive redness, swelling, tenderness, pus or bleeding. The area around the tube should be cleansed with hydrogen peroxide to remove any dried exudate and wiped dry. A 4x4, slit in the middle, should cover the insertion site. The 4x4 should be taped to the abdomen and the tube can also be looped (being careful not to kink it) and taped to the abdomen to prevent dislodgement.

. Complications

A. Diarrhea

Diarrhea is the most common complication of enteral feeding and may be difficult to remedy. Solutions to the problem include decreasing the rate or concentration of the solution to a previously tolerated level, switching formulas, or, as a last resort, adding antidiarrheal medication (Kaopectate or Lomotil) to the patient's medication regimen (this requires a physician's order).

While it may be difficult to keep the patient clean and dry, this is imperative since in a depleted nutritional state, he will be more prone to skin breakdown and the development of decubitus ulcers than usual. Persistent diarrhea may represent an underlying medical illness which may require specific intervention (e.g. antibiotic associated colitis).

B. Aspiration

Aspiration is another frequent complication. This can be prevented by withholding feeding if gastric residual contents are greater than 100 ml. The head of the bed must always be elevated to 30 degrees and the patient not allowed to lie flat until two hours after the completion of the feeding. If the patient has persistent hiccipping heartburn, or is vomiting gastric contents the feedings should be discontinued and medical evaluation performed.

C. Tube Dislodgement

The feeding tube should always be tested for proper placement. If a tube becomes dislodged, the physician, the enterostomal nurse or the nutrition support nurse should be notified. Gastrostomy and jejunostomy tubes should be promptly reinserted to prevent closure of the fistula tract. It should be stressed to the patient during discharge planning, that if the tube comes out at home, he should return to the hospital as soon as possible on the same day for reinsertion.

D. Tube Migration

Balloon tipped catheters may be carried distally by peistalis if the balloon is left inflated or over inflated. This complication is prevented by removing the inflation port. The nurse may suspect this complication if a gastrostomy tube disappears (partially or totally) into the patient, the length of tube protuding from the stomach diminishes, if the patient has nausea or vomiting, signs of gastrointestinal obstruction or signs consistent with gastro intestinal perforation (peritonitis, abdominal pain, fever) are present.

PARENTERAL NUTRITION

Total parenteral nutrition can be given through the peripheral veins or through a subclavian or jugular vein. The peripheral route may be used as an adjunctive treatment, in instances where enteral nutrition is not possible, or when high calories and nutrients are not indicated. Total parenteral nutrition (TPN) through the great veins is meant as a total nutritional regimen providing high calories and nutrients with dextrose as the main calorie source. The total system also generally includes a fat emulsion solution (intralipid) that is used as a calorie source and in the prevention of essential fatty acid deficiency.

I. General Considerations

The following apply to both types of parenteral nutrition.

1. All bottles of hyperalimentation fluid should be refrigerated upon arrival to the floor. This will retard the growth of microorganisms that may be a cause of sepsis for the patient when the bottle is actually hung.

2. All bottles of TPN should be checked against the original Doctor's Order sheet before hanging. As a further precaution against error, the nurse receiving the fluids from Pharmacy should also check the fluids and fluid label against the Doctor's Order sheet before refrigerating them. An error found at this time will be easier to correct than one found at the time the fluid is needed to hang. This double-check procedure can virtually eliminate error.

3. The bottle should be removed from the refrigerator about 1/2 hour prior to administration in order to warm it slightly and eliminate chilling of the patient.

4. All unused or "change of order" fluids should be returned promptly to pharmacy. TPN expires 24 hours after its arrival on the floor and should not be used after that time period.

5. No bottle of TPN should be left hanging for longer than 24 hours. The bottle should be discarded at the end of 24 hours and a new bottle hung. Bacterial and fungal growth in the fluid can cause lifethreatening complications.

6. Before hanging, the fluid should be checked for precipitate, turbidity and any cracks or leaks in the bottle. It should be returned to pharmacy if any of the above are present.

7. If the fluid runs out and no new bottle is readily available, a solution of D10/W must be hung and the pharmacy notified that a new bottle of fluid is needed as soon as possible. This prevents hypoglycemia.

8. Physicians should be encouraged to write their TPN orders as early as possible in the day (before 12 noon) and the orders sent to pharmacy promptly to ensure delivery when needed and adequate preparation time.

9. An infusion pump device should be used for all TPN. This ensures a constant rate of flow. The rate of flow should be checked every hour. The maximum amount of rate adjustment should not exceed 5% (5 to 10 ml. per hour) of the ordered flow rate. "Catching up" can be harmful to the patient. Sometimes, changing the IV tubing, the patient's position, or switching to another infusion pump will remedy the problem of a too slow rate. If an infusion device continues to alarm without obvious cause, then a different pump should be obtained. TPN should never run without the assistance of an infusion device and problems with the flow rate should be resolved rather than abandoning the infusion device and allowing the fluid to flow without mechanical monitoring. A too fast or too slow rate an cause life threatening complications for the patient and should be avoided.

10. TPN should be tapered over 48 - 72 hours prior to surgery and prior to discontinuation. This allows the patient's metabolic system to slowly adapt to the change.

11. When initiating TPN, fluids are gradually increased over 24 - 48 hrs. The solution should be increased by no more than one liter per 24 hours until the desired rate or the rate at which the patient tolerates the fluids is achieved. The concentration may also be titrated in the same fashion.

12. Prior to the initiation of hyperalimentation, a signed consent form must be obtained from the patient, or, if he is incompetent, from his family. (See Medical Center Memorandum #83-11)

A. Peripheral TPN

1. The highest final concentration of dextrose that can be infused through a peripheral vein is 10%. Higher concentrations should be reserved for the subclavian vein.

2. Even lower concentrations of dextrose can be very irritating to the peripheral veins. Daily site care and inspection should be performed and any sign of swelling, pain or redness should be reported. Site should be rotated every 48 - 72 hours or sooner, if indicated. If phlebitis is left unchecked, sloughing of tissues may occur.

3. Intravenous fat emulsions are frequently hung to run concurrently with peripheral TPN to decrease the incidence of phlebitis. The fat emulsion solution should be piggybacked into the Y site closest to the site of insertion to decrease the amount of mixing with the TPN. The Y site should be cleansed with an alcohol pad. A #19 or #20 gauge needle attached to the fat emulsion tubing should be inserted at the site and securely taped to prevent dislodgement. The fat emulsion should run through an infusion device to ensure a constant rate. Never run intralipids through a filter.

4. When using a fat emulsion solution concurrently with peripheral TPN, the entire tubing set-up should be changed every 24 hours, when the new bottle of TPN is hung. This decreases the risk of infection from frequent entry into the Y site which violates the sterility of the system. When fat emulsions are not used, the tubing should be changed every 48 hours, with the new bottle of TPN.

5. No medications, blood or other IVs should be hung on the TPN line. For IVPB medications or additional fluid requirements, another IV should be started at a different site.

B. Central Venous TPN

1. The highest acceptable final concentration of dextrose that can be hung through a CVP line is 47%. This concentration is reserved for patients with renal failure. The standard concentration is generally 25% or less.

2. Dressing changes and IV tubing changes should be done according to procedure (see "Catheter Insertion" and "Catheter Maintenance" procedures). When using fat emulsions, the tubing should be changed every 24 hours, from the extension tubing distally, with the first new HAF bottle hung each day.

3. All tubing connections must be securely taped to prevent accidental dislodgement and potential complications.

4. Only TPN and fat emulsions are to be hung on the CVP line. Other fluids, medications, blood drawing and blood administration require a separate line. Only in cases where no other access is available and this is documented in the medical record, can this be violated.

5. Prior to initiating TPN through a CVP line, the nurse must receive confirmation of the proper placement of the catheter tip from the physician and this should be documented in the progress notes.

6. When a CVP line becomes clogged or otherwise non-functional, the physician or nutritional support nurse should be notified immediately.

C. Fat Emulsions

1. Fat emulsions should be left at room temperature and never refrigerated. Refrigeration may cause separation of the solution.

2. Any fat emulsion solution that is separated should be returned to pharmacy unopened. No attempt should be made to shake the solution to mix it, as separation is not normal.

3. Fat emulsions should hang no longer than 24 hours because they are a medium for bacterial growth when opened.

4. Only special fat emulsion infusion tubing should be used with these products. Certain components of the commonly used IV tubing may mix with the fat emulsion and could cause an adverse reaction. It is for this reason, also, that fat emulsions are piggybacked into the most proximal Y site of the IV tubing, to alleviate the mixing of IV tubing components.

5. Initially, a fat emulsion should be slowly infused at 1 ml./minute for the first 15 - 30 minutes. If no untoward reaction occurs (dyspnea, cyanosis, allergic reactions, headache, flushing, nausea or vomiting, or pain in the chest or back), then the emulsion may be adjusted to the ordered rate. If a reaction occurs, the infusion should be discontinued and the physician notified.

6. Generally, the minimum amount of time that a 10% solution should run in is over 4 hours. A 20% solution should run in a minimum of 8 hours.

7. Fat emulsion ideally should be administered through an infusion control device.

8. No filters should be used with fat emulsions, due to the size of the fat droplets.

II. Monitoring Patient

The following apply to both modes of TPN.

A. Daily weights should be taken on the patient. These should be done at 6:00 a.m. on the same scale each day and recorded. On a comatose patient or one who is difficult to weigh, three times per week is the absolute minimum.

B. Intake and output is to be recorded every shift on the appropriate form. It is important to differentiate on the form between the different types of fluids infused (i.e., TPN, PIV, Intralipids, p.o., tube feedings, etc.) in order to monitor the patient for adequate caloric and fluid intake. Output should be differentiated in a similar fashion. (See Appendix III).

C. Urine S&A's should be checked every 6 hours (5a-11a-5p-11p) with Ketodiastix or Testape and recorded on the appropriate form. Glycosuria of 1/2-3/4% is a generally acceptable level, but higher results should be reported to the physician. Insulin may need to be added to the patient's medication regime if glycosuria persists or, this could be a sign of impending sepsis.

D. Urine specific gravity should be done and recorded every 6 hours (5a-11a-5p-11p) on the appropriate form. Normal values are 1.002 to 1.020. Changes may indicate dehydration or osmotic diuresis and should be reported.

E. Vital signs should be taken and recorded every shift. Any temperature of 101 degrees orally should be reported. This may be one of the first signs of sepsis.

F. Mouth care should be done every shift to keep the mucous membranes in the oral cavity moist and prevent the development of dental caries and infections. Teeth should be brushed daily.

G. Range of motion exercises should be done at least daily to promote circulation and maintain muscle tone. Patients who are able should be encouraged to sit up and ambulate several times a day to try and alleviate the weakness and lethargy that may result from prolonged bedrest.

III. Complications (see also "Complications" section of Parenteral Nutrition Support

A. Phlebitis may occur in peripheral HAF administration. The area surrounding the insertion site will be reddened, swollen, or painful. There may be red streaks up the arm and these may be leaking at the site. Daily inspection of the site for signs of phlebitis and frequent (every 72 hours or less) site change can virtually eliminate this complication.

B. Pneumothorax may occur during CVP catheter insertion. The patient may be dyspneic, cyanotic and complain of chest pain. In some instances, this will resolve on its own. In other cases, it may require the insertion of a chest tube to reinflate the lung. The physician should be notified and a chext X-ray should be ordered if symptoms develop. Continue to observe the patient for any further problems.

C. Air embolism occur during CVP catheter insertion, during tubing changes, if the tubing becomes disconnected, or after removal of the CVP catheter. The patient may exhibit signs of dyspnea, tachypnea, cyanosis, disorientation, paresis, tachycardia and may complain of chest pain. If this occurs, the patient should be placed in deep Trendelenburg position and told to lie on his left side. This should keep the air bubble in the right side of the heart and prevent its entry into the left ventricle. Needle aspiration of the heart may be necessary to remove the air. Preparation for possible cardiac arrest should be enacted.

To prevent this, the patient should always be in Trendelenburg position during catheter insertion. The valsalva manuever should be done during tubing changes and when the catheter is removed. All connection sites should be securely taped to prevent accidental dislodgement. When removing the catheter, a sterile occlusive dressing with povidone-iodine ointment should be applied over the insertion site to prevent embolism until the site heals.

D. Hyperglycemia can occur from diabetes, rapid infusion, or surgical stress. It may be precursor to sepsis. Blood glucose levels will be elevated and there will be glycosuria of 2% or more. This can be treated with administration of regular insulin subcutaneously or IV. The rate of TPN fluid may need to be decreased or stopped until levels return to normal.

The physician should be notified immediately of glycosuria or an elevated serum glucose. This can be prevented or at lest controlled by daily blood glucose monitoring, insulin coverage on a sliding scale and a slow initiation ot TPN to allow the patient's metabolic system to adapt to the increase in glucose load.

Uncontrolled hyperglycemia manifests itself by blood glucose levels of 500 - 1000 mg/100 ml., osmotic diuresis, lethargy, coma and even death. This can be prevented by proper, immediate control of blood glucose levels greater than 200 mg%, immediately notifying the physician, stopping the hypertonic solution, starting isotonic infusions and initiating insulin.

E. Sepsis (see also "Infection Control" section) This is caused by a break in sterile technique during catheter insertion, dressing changes or solution compounding. Sepsis manifests itself by glycosuria, temperature of 101 degrees or greater, hypotension, disorientation and inflammation or drainage at the insertion site. This can occur with either central or peripheral TPN.

The physician should be notified immediately. Cultures should be obtained per the infection control protocol. A chest X-ray should be done. Generally, the patient's temperature should return to normal within 48 hours and symptoms should abate.

The best sepsis prevention is adherence to strict aseptic technique during all facets of catheter care and maintenance in conjunction with sterile preparation of solutions.

CVP CATHETER INSERTION

The hyperosmolarity of hyperalimentation solutions requires that they be infused into the great veins where blood flow is sufficient to rapidly decrease the concentration of the infusate and to more rapidly disperse it throughout the system. The subclavian vein is the recommended access site. Less acceptable but occasionally used sites are the external jugular vein and the median basilic vein in the antecubital fossa. The latter two sites have less adaptibility for long term use due to extraordinary limitations in patient activity and patient discomfort and should only be used in instances where the preferred access site is not feasible (i.e. head and neck cancer, thoracic surgical sites, tracheostomy) or when short term (<1 week) therapy is indicated.

The patient should be thoroughly informed and educated concerning the procedure of subclavian catheterization prior to the procedure. Benefits, risks, the procedure itself, pain to be experienced, the purpose of the post-insertion x-ray and eventual therapy should be explained to the patient to increase cooperation on the patient's part in the long-term therapy plan.

The nutritional support team nurse should be notified that subclavian insertion is being considered on a patient. The nurse will assist in the teaching and will provide psychological preparation to the patient as well as assist in the actual procedure. The insertion of CVP catheters during off hours and on weekends and holidays should be discouraged except in emergency instances.

NOTE: Signed informed consent must be obtained by the patient or his family in order to initiate hyperalimentation (See VA Medical Center Memorandum No. 83-11)

EQUIPMENT

CVP catheter - commonly 14g, 12 inches
IV fluids (isotonic), tubing and arterial pressure tubing to be used as extension tubing
Defatting agent (Vythene, other adhesive remover or alcohol)
Povidone iodine scrub, solution, and swab sticks)
Sterile gloves
Surgical mask
Surgical cap
Sterile gown
Sterile drapes
Suture material (3-0 silk)
IV pump
Waterproof adhesive tape and 2x2 gauze or transparent adhesive dressing

PROCEDURE	KEY POINTS
1. The CVP catheter is inserted by the physician.	
2. Place the patient in Trendelenberg position.	This facilitates filling the subclavian or jugular vein making it easier to find. A rolled towel may also be placed under the shoulders for ease of access. Trendelenberg position is not recommended in patients with a possibility of increased intracranial pressure.
3. Prepare equipment. The IV set-up should be primed with solution, arterial pressure tubing attached and the connection site taped.	
4. Shave site of insertion if necessary.	This should be done ONLY in instances where excessive hair is present. Closely clipping the hair would avoid skin abrasion which later may be a potential site for infection.
5. Apply mask and cap.	
6. Wash hands, apply sterile gloves and don gown. Drape patient in sterile fashion. Patient's head should be turned away from the insertion area or a mask placed on the patient.	
7. Defat skin with defatting agent.	In instances where a patient may have an allergy to the agent, alcohol (70% Isopropyl) may be substituted.

PROCEDURE	KEY POINTS
8. Apply iodophor scrub and iodophor swabs to the skin starting at the insertion site and spreading the solution in a spiral pattern.	Allow povidone iodine solution to stay on the skin for 1 minute to kill skin flora. Alcohol may also be used in like fashion if the patient is allergic to iodine.
9. Inject 1% lidocaine, for injection, at the insertion site.	This should numb the area and allow ease of insertion.
10. Insert the catheter and when blood return is established, connect the isotonic (D5/W) IV solution tubing to the hub of the intracath.	
11. The catheter guard should be securely sutured to the skin.	This will prevent dislodgement.
12. A portable chest x-ray must be taken immediately after insertion.	
13. Confirmation of correct placement of the catheter is done by the physician and charted in the progress notes. This should be communicated to the charge nurse and the pharmacy.	Hyperalimentation through the line will not begin until proper placement is verified and documented.
14. Apply a small amount of povidone-iodine ointment to the insertion site.	This prevents seeding of organisms into the insertion site.
15. Cover the area with a 2x2 gauze pad and waterproof, non-permeable tape. A sterile, adhesive, vapor permeable clear dressing may also be used when available.	The dressing should be an occlusive one.
16. All connection sites should be taped securely	This will prevent dislodgement.

CVP CATHETER MAINTENANCE

The CVP dressing changes should be done every 48 - 72 hours (Mondays, Wednesdays, and Fridays), or more often if there is leakage, pain at the site, or gross soiling. This should be done in conjunction with the hanging of a fresh solution and tubing. If intralipid has been piggybacked into the IV tubing, then the tubing should be changed with the next new bottle of HAF, from the end of the extension tubing distally.

PROCEDURE	KEY POINTS
1. Put on mask.	
2. Wash hands.	
3. Have the patient lay flat in bed. Have patient turn away from catheter site or have patient wear a mask.	
4. Remove old dressings surrounding the catheter site.	Wear gloves or use forceps to remove soiled dressing.
5. Inspect the catheter site for signs of inflammation, the presence of facial or neck swelling; leakage of fluid or neck vein distention. Notify the physician if any of the above symptoms are present.	
6. Put on sterile gloves.	
7. Defat the area surrounding the catheter with defatting agent or alcohol.	Alcohol is used when allergies to defatting agents are present.
8. Cleanse the area surrounding the catheter with povidone-iodine scrub in spiral fashion from insertion site, then solution.	Solution should remain on the skin for one minute to kill skin flora. Use alcohol if allergy to iodine present in like fashion.
9. Change the IV tubing with connected arterial pressure tubing.	This tubing has a luer lock connection.
9a. Instruct the patient on doing the valsalva technique when disconnecting the IV tubing from the catheter.	This maneuver helps prevent the introduction of air into the catheter.

PROCEDURE	KEY POINTS
10. Place a 2x2 gauze pad over the catheter site. Apply adhesive, waterproof, non-permeable tape to cover the dressing site completely. or Use a sterile, adhesive, vapor permeable, clear dressing over the site.	For better adherence around bony prominences, tincture of benzoin may be applied to the skin surrounding the dressing. The dressing must be an occlusive dressing.
11. Loop the arterial tubing so as to prevent pulling of the catheter.	
12. Tape all connections between arterial pressure tubings and IV tubings.	This will prevent dislodgement.
13. Dressing and IV tubing changes should be recorded on VA Form 10-7978j IV infusion overprint.	
14. CVP catheters are to be removed by the ward physician or under direct order of a physician by the hyperalimentation nurse.	

ADMINISTERING IV FLUIDS THROUGH THE IVAC
VARIABLE PRESSURE VOLUMETRIC PUMP - MODEL
560

I. PURPOSE: To establish a procedure for the safe administration of IV fluids through the use of a mechanical pump.

II. GENERAL INFORMATION:

1. All hyperalimentation fluids and IV solutions containing Heparin, Aminophylline, or cardiac or anti-hypertensive drugs as well as medications or fluids requiring close monitoring and titration should be placed on the IVAC pump.

2. Nipride, Intralipids and Nitroglycerine require special tubing. Unless that tubing is available, the IVAC 560 pump should not be used. The IVAC 530 pump should be used in its place.

3. A special feature of this pump is its capability of taking central venous pressure readings. (See Nursing Procedure on CVP Readings)

4. The pump should be plugged in to an electrical outlet to keep the battery charged. A freshly charged battery can run the pump for a maximum of seven hours, which allows for periods of patient ambulation and traveling to tests. An alarm will sound if the battery is low. Indicator lights on the bottom of the display panel light up, indicating battery or electrical outlet operation.

III. EQUIPMENT:

IV fluids, as ordered, properly labeled
IV Tubing - IVAC 52 series volume infusion set only
IVAC 560 PUMP (See attached diagram, Figure 1)
IV secondary set (if receiving IV piggyback medications)
IV Record sheets -- VA Form 10-7978 - Intravenous Infusion Overprint

IV. PROCEDURE	KEY POINTS
a) Starting the Infusion	
1. Identify patient.	
2. Check to be sure that IV fluids correspond with the physician's orders on the right patient.	
3. Close clamp on IV tubing and place the spiked end into the entrance port on the bag of IV fluid, using sterile technique.	Sterile technique must be maintained to prevent the entrance of microorganisms into the IV fluids, which can become a medium for growth.
4. Suspend IV container on the IV pole.	
5. If extension tubing is to be used, it should be connected and secured at this time, using sterile technique.	
6. Fill drip chamber to the fill line by gently squeezing and then releasing the drip chamber. Allow sufficient air space in the drip chamber between the fluid level and the drop-forming orifice for flow-sensor placement.	Overfill of the drip chamber will cause the pump to alarm. (See diagram, Figure 2 Page 74.)
7. Prime infusion set by slowly opening the regulating clamp.	If using extension tubing, the luer lock tip must be removed to allow for proper priming.
8. Grasp pressure sensing membrane between thumb and forefinger, hold flat and invert, tapping gently to expel trapped air.	Air in the tubing can cause air embolism in the patient. It will also cause the pump to alarm.

IV. PROCEDURE, CONTD.

KEY POINTS

9. Close regulating clamp.

10. Venipuncture should be performed by qualified personnel and the IV should be patent before proceeding.

11. Press the "on/off" switch on the pump. Display panel will read "Load Set."

12. Open the door to the pump.

13. Place tubing retainer in the slot at the top of the inside of the pump.

See diagram, Figure 3 Page 74

14. Place membrane disk in the pressure sensor opening with the winged side facing outward.

15. Place lower end of tubing into the tubing guide post at the bottom of the machine.

16. Be sure that the tubing between the retainer and the membrane is toward the left side of the tubing pincher.

When the door is closed, the tubing will automatically be pushed into the pincher. Forcing the tubing into the pincher manually or placing it on the right side of the pincher will cause the pump to alarm.

. Close and latch the door. Display panel will read "position flow sensor - open clamp."

17. Close and latch the door. Display panel will read "position flow sensor - open clamp."

IV. PROCEDURE, CONTD.	KEY POINTS
18. Flow sensor should be placed on the drip chamber between the fill line and the drop-forming orifice.	The flow sensor should be placed so that the upper surface is slightly below the drop-forming orifice and the fluid level is below the lower surface of the drip chamber. Improper placement will cause the pump to alarm.
19. Open the regulating clamp.	
20. The display panel will read "clear Vol" (Clear volume)	
21. To clear volume, press the "Clear Vol Inf" switch and hold for 1 second until the display panel reads 0.	If volume infused is to be retained, press the start/stop" switch for the next message. The pump will display volume infused to 9999 ml.
22. Display panel will read "set rate."	To retain set rate, press "start/stop" switch.
23. Set the rate by pressing the up/down switches, (indicated by arrows;)	The pump can be set to deliver from 1 ml/h to 499 ml/h in 5 ml/h increments.
24. Press "start/stop" switch to begin infusion.	
25. Chart IV on VA Form 10-7978 - IV Infusion Overprint.	
26. To set a volume limit to be delivered (e.g. 500 mL of a 1000 mL bag of fluid) press the "set vol limit" switch while pressing the up/down switches (arrows) to the desired limit.	The pump will automatically return to 0 each time it is turned on. So this must be set each time the pump is turned on, if desired.

IV. PROCEDURE, CONTD.

KEY POINTS

b) To Change Settings or Interrupt Infusion

1. To change the infusion rate, press the "set rate" switch while pressing the up/down switches to the desired new rate. The pump will begin again when the switches are released.

2. To interrupt the infusion, press the "start/stop" switch, which places the pump on hold.

This can be used when hanging a new IV bottle, hanging an IV piggyback medication, or when changing the tubing.

3. To resume infusion, press the "start/stop" switch again.

If the "start/stop" switch is not pressed again to resume the infusion, after 2 minutes an alarm will sound and the display panel will read "Time Out." Press "start/stop" switch once again place the pump on hold or twice, to start the infusion.

c) To Infuse IV Piggyback Medications

1. Use the upper Y-site to spike the IV piggyback medication and primed tubing into the primary set, using sterile technique and swabbing the Y-site injection port with an alcohol pad.

When hanging intralipids or other IV's that must run concurrently with the fluids on the pump the pump may be bypassed by inserting a needle and tubing at the "Y" site closest to the patient. These fluids can then run in freely or be infused by another pump.

2. Press "start/stop" switch once to place the pump on hold.

3. Close the regulating clamp on the primary IV set.

IV. PROCEDURE, CONTD.

KEY POINTS

4. Open the regulating clamp on the secondary medication set.

5. Remove flow sensor from the drip chamber on the primary set and place on the drip chamber of the secondary set.

Flow sensor should be placed so that the upper surface is slight below the drip forming orifice and the fluid level is below the lower surface of the drip chamber. Improper placement will cause the pump to alarm.

6. Set the secondary infusion rate and volume limit, if desired, on the pump, as previously described.

7. Press the "start/stop" switch to begin infusion.

8. When the container is empty, the pump will alarm and the display panel will read "bottle clamp."

9. Press "start/stop" switch to place the pump on hold.

To hang another IV piggy-back medication, repeat procedure from Step 1.

10. Close regulating clamp on secondary set and open clamp on primary set.

11. Remove flow sensor from secondary set and place on primary set drip chamber.

12. Reset the infusion rate to the prescribed infusion.

13. Press the "start/stop" switch to begin infusion.

d) Changing the IV Tubing

1. Press "start/stop" switch to place pump on hold.
2. Close regulating clamp on IV tubing.
3. Open door to pump.
4. Remove tubing from tubing retainer at top of machine and membrane from pressure sensor slot.
5. Push tubing pincher mechanism to the right to remove tubing from this mechanism.
6. Place new tubing in machine, as previously described.

V. ALARMS

The pump has an alarm system that will sound and a message that will read out on the display panel to indicate problems.

VI. DISPLAY PANEL MESSAGE	CAUSE
1. Bottle Clamp	The container is empty, the regulating clamp is closed or air is trapped in the tubing spike that is placed in the entrance port of the IV solution. Gently squeezing the drip chamber to replace air with solution should rectify this last problem.
2. Occluded	Kinked tubing, clogged tubing, infiltration. Check patient position and IV site.
3. Infusion Complete KVO 5mL/hr	Pre-set volume limit has been reached. Reset volume limit.

VI. DISPLAY PANEL MESSAGE, Contd.	CAUSE
4. Low BATT	Battery is discharged. Plug unit in to resume charge and reset "start/stop" switch.
5. DOOR	Door not closed and/or latched properly.
6. SET OUT	IV tubing removed or not properly placed in the inner mechanism of the pump.
7. RATE = 000	Flow rate is set to 000, which is too low to operate pump.
8. Flow Sensor	Drip chamber too full; drops splashing in drip chamber causing false reading by flow sensor. Improper tubing for pump being used. Flow sensor unplugged from pump or incorrectly positioned on the drip chamber.
9. Time Out	The pump has been on hold for 2 minutes. Press "start/stop" switch to resume hold or resume infusion.
10. Fix Me	May be internal malfunction. TURN pump OFF and try procedure again. If pump still will not run, obtain new pump.

IVAC® MODEL 560

VARIABLE PRESSURE VOLUMETRIC PUMP

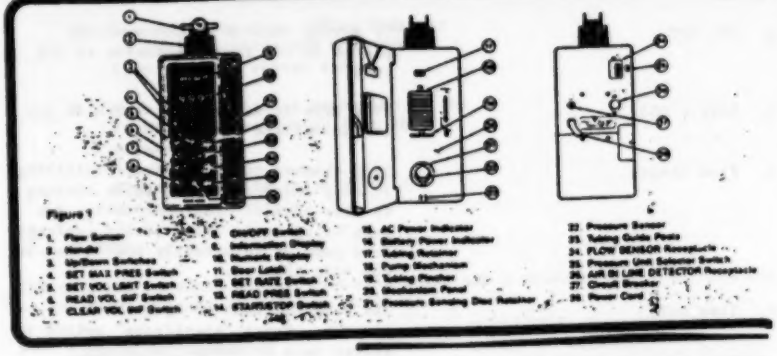

Figure 1

1. Flow Sensor
2. Handle
3. Up/Down Switches
4. SET MAX PRES Switch
5. SET VOL LIMIT Switch
6. READ VOL INF Switch
7. CLEAR VOL INF Switch
8. ON/OFF Switch
9. Information Display
10. Numeric Display
11. Door Latch
12. SET RATE Switch
13. READ PRES Switch
14. START/STOP Switch
15. AC Power Indicator
16. Battery Power Indicator
17. Tubing Retainer
18. Pump Mechanism
19. Tubing Platter
20. Mechanism Panel
21. Pressure Sensing Disc Retainer
22. Pressure Sensor
23. Tubing Guide Pins
24. FLOW SENSOR Receptacle
25. Pressure Unit Selector Switch
26. AIR IN LINE DETECTOR Receptacle
27. Circuit Breaker
28. Power Cord

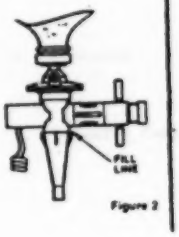

Figure 2

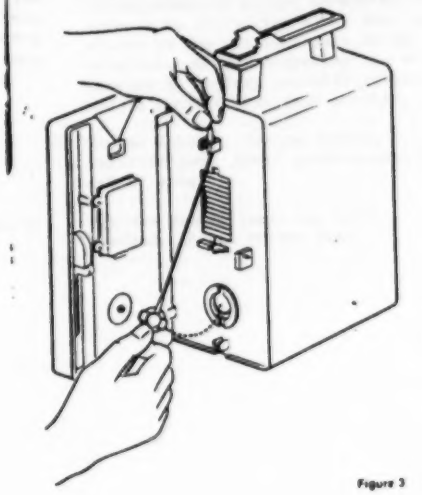

Figure 3

VII. Nursing Service References

1) Patient Care Memo 84-1 "Administration of IV Medications by Registered Nurses" dated January 17, 1984.

2) Nursing Service Memorandum No. 32. "Approval to Perform Venipunctures by Registered Nurses' List," dated January 1984.

3) "Administration of Intravenous Fluids," dated August 1982.

4) "IV Catheter Insertion, Maintenance and Removal," dated August 1982.

REFERENCES

1. Bayer L, Feurer I. Nutritional Assessment in Critical Care. Critical Care Nursing Currents. 1:1-6, Oct-Dec 1983.

2. Grant P. Handbook of Total Parenteral Nutrition. Philadelphia, W.B. Saunders Co., 1980.

3. Griggs B, et al. A Basic Nursing Guide To Providing T.P.N. For The Adult Patient. Washington, D.C., American Society for Parenteral and Enteral Nutrition, 1984.

4. Hutchison M. Administration of Fat Emulsions. Am J Nurs. 82:275-277, February, 1982.

5. Keithley J K, Fraulini E. What's Behind the I.V. Line? Nursing 82. 82:33-42, March 1982.

6. Konstantinides N, Shronts E. Tube Feeding: Managing the Basics. Am J Nurs. 83:1312-1320, September 1983.

7. Ostrow LS. Air Embolism and Central Venous Lines. Am J Nurs. 81:2036-2038, November 1981.

8. Proceedings of the Ross Laboratories Workshop on Contamination of Enteral Feeding Products During Clinical Usage. Columbus, Ohio. Ross Laboratories, 1983

9. Silverman H, Eisenberg D. Parenteral and Enteral Nutrition For The Hospitalized Patient. Norwalk, CT. Appleton-Century-Crofts, 1982.

10. Vasquez R M. A Manual of Nurtitional Support. Chicago, IL Northwestern University, 1982.

INFECTION CONTROL IN TOTAL NUTRITIONAL SUPPORT

A. INTRAVASCULAR:

I. INTRODUCTION:

The cardiovascular system is normally sterile. Therefore, all devices with access to (or direct contact with) this body system must be sterile. Medical devices are commonly used for administering solutions or medications, for hemodynamic monitoring, diagnostic testing and maintenance of cardiac and renal function. Whenever anything is inserted or infused into the vasculature, the skin intergity is altered and then no longer prevents the entrance of microorganisms into the system. Microorganisms which gain entry from a contaminated catheter or entry point are then free to cause infections within the body. To reduce the risk of infection, specific methods of care must be followed for catheter insertion, line maintenance and use of intravenous fluids.

II. HOST FACTORS THAT INCREASE THE RISK OF INFECTIONS ASSOCIATED WITH INTRAVASCULAR DEVICES INCLUDE:

A. Trauma or pre-existing infection at or near the insertion site; (e.g. burns, surgical wounds).

B. Immunosuppression such as granulocytopenia, corticosteroid use or chemotherapy.

C. Cardiovascular implants.

D. Cardiovascular structural defects, including congenital anomalies and valvular disease.

E. Pre-existing infection at remote sites which can contaminate IV catheters via hematogenous spread.

F. Severe malnutrition.

III. ALTERATIONS OF THE CARDIVASCULAR SYSTEM THAT INCREASE RISK OF INFECTION

A. Disrupted Blood Flow in Vessels

1. Atherosclerosis -- Decreases blood flow to tissues by blocking normal pathways. Ischemia or necrosis develops distal to obstruction and invasion site of organisms.

2. Vasculitis -- Inflammation of vessel walls leading to tissue necrosis with subsequent bacterial invasion. Local or disseminated infection can occur.

B. Disrupted Cardiac Blood Flow

1. Valvular heart disease -- Deformed heart valve decreases tissue perfusion and possibly local or disseminated infection.

2. Congenital heart malformations (e.g. patent ductus) -- Oxygenated and deoxygenated blood are mixed leading to inadequate tissue oxygenation and nutrient/waste product exchange. Malnutrition may occur increasing host vulnerability in infections such as pneumonia. Turbulent blood flow leads to vessel lining trauma providing a receptive environment for microbial invasion.

C. Trauma

1. Lacerations, injuries, etc -- Disrupts continuity of vessels, injures tissue and may lead to ischemia or direct exposure to microorganisms. Local or systemic infection may occur.

IV. PROCEDURES/DEVICES ASSOCIATED WITH RISK OF INFECTIONS:

A. Cannulae

1. May provide a route of entry for microorganisms.

2. Longer catheters are generally associated with increased risk of infection.

B. Site Selection

1. Lower extremity insertion sites in adults are associated with a greater risk of infection than upper extremity sites.

2. Risk of infection is greater when the catheter is inserted adjacent to an open wound (e.g. tracheostomy) or when the vein has been used for prior total parenteral nutrition (TPN) therapy.

C. Preparation of Site

1. Prepare site with iodine, iodophor, 70% alcohol or chlorhexidine. Inadequate site preparation increases risk of infection from cutaneous flora.

2. The microorganisms found at the insertion site are primarily from the hands of personnel inserting the cannula.

3. Other sources for these organisms include contaminated antiseptics, breaks in aseptic technique, localized skin irritation from shaving or application of acetone.

D. Methods of Cannula Insertion

1. Use of good sterile technique reduces infection risk.

2. Percutaneous cannula insertions are associated with less infection risk than surgical cutdown insertions.

3. Movement of the catheter may allow microorganisms to migrate inward. Secure cannula and apply topical antibiotic or antiseptic ointment to site immediately after insertion, especially for cutdowns.

E. Duration of Use

1. Risk of infection increases with duration of cannula use

INSERTION SITE	LOCATIONN OF TIP	USE	FREQUENCY OF CANNULA CHANGE	FREQUENCY OF ADMINIS. SET CHANGE
Central vein (jugular or subclavian)	Central vein	TPN	not routinely	24-48 hours
Peripheral vein	Central vein	TPN	48-72 hours	24-48 hours
Peripheral vein	Peripheral	TPN	48-72 hours	24-48 hours
-	-	Lipid emulsions	Same as main line	With each new bottle

2. Duration of solution used

SOLUTION	FREQUENCY OF SOLUTION CHANGE
Hyperalimentation	24 hours
Lipids	12/24 hours

F. Maintenance of Insertion Site

1. Inspect insertion site daily for complications and change the sterile dressing every 48-72 hours for peripheral and central cannulae that must remain in place for prolonged periods since most IV-related infections occur from inward progression of microorganisms via the cannula wound.

G. Special Use Cannulae

1. Large-bore, silicone catheter inserted via a cutdown into a central vein and threaded into a right atrium or superior vena cava used for long term IV therapy. The extra-vascular portion of the cannula has a dacron cuff to anchor the cannula in place in the subcutaneous tissue. (Infection rate reported to be 7.5 catheter-related infections/1000 catheter use days). Inserted in the operating room.

   a. Hickman
   b. Broviac
   c. Double-lumen (increased subcutaneous tunnel infection is associated with double-lumen catheter)
   d. Triple-lumen

H. Fluid Administration Sets

1. Caution! Any break in the sterile closed system used to deliver intravascular fluids poses a risk of contamination since the fluid delivery system acts as a reservoir for microbial growth.

   a. Organisms can migrate against a steady flow of fluid;
   b. Risk of contamination increases with the duration of use;
   c. Most frequent source for contamination is extrinsic;
   d. Fluid systems particularly prone to contamination include those:

      1. Used for TPN

      2. Frequently manipulated

         a. No piggyback, administration should be inserted into TPN lines.
         b. In special cases where no other line is available, the physician is responsible to justify this procedure in the progress notes.

c. Intravenous fat emulsions are the only routinely accepted solution that can be piggy-backed.

I. Filters

1. Types:

a. 0.22 micron membrane filter will retain all particulate matter, bacteria and fungi for up to 12 hours; may require use of a positive-pressure pump.

b. 0.45 micron membrane filter will retain most bacteria and fungi and all particulate matter for up to 6-8 hours; allows gravity flow of solution.

2. Not recommended as a routine infection control measure because:

a. Fluid delivery systems may become contaminated during insertion of a filter.

b. Filters do not reduce the risk of contaminates entering below the filter.

c. Filters may reduce potency of drug additives due to binding of the drug to the filter.

d. Filters do not block endotoxins.

J. Total Parenteral Nutrition Solution (TPN)

1. TPN therapy is most frequently complicated by fungal septicemia, particularly candida sp. (patients are often critically ill, compromised hosts receiving broad spectrum antibiotics; TPN solutions provide an acceptable growth medium).

2. Lipid emulsions readily support the growth of a variety of organisms including candida and most bacteria.

V. PATHOGENS MOST COMMONLY RESPONSIBLE FOR INFECTIONS

A. Pathogens associated with TPN solutions

1. Hypertonic glucose (10%)	Candida sp.
2. Hypertonic glucose (50%)	Does not support growth of organisms
3. Amino acids (50% Dextrose)	Candida sp. Torulopsis glabrata
4. Amino acids (5% Dextrose)	Candida sp. Enterococcus

5. Lipid emulsions — Most bacteria, Candida sp.

B. Organisms associated with intravascular related infections

1. Cannula

a. Staphylococcus aureus
b. Staphylococcus epidermidis
c. Klebsiella
d. Serratia marcescens
e. Enterococci
f. Acinetobacter sp.
g. Pseudomonas aeruginosa
h. Pseudomonas cepacia
i. Diptheroids

2. Contaminated infusions

a. Extrinsic

1. Tribe Klebsiella (90%)
   a. Klebsiella
   b. Enterobacter
   c. Serratia
2. Pseudomonas cepacia
3. Citrobacter freundii
4. Flavobacterium

b. Intrinsic

1. Enterobacter
2. Pseudomonas cepacia
3. Citrobacter
4. Salmonella choleraesuis

3. Hyperalimentation (most catheter-related)

a. Candida sp. (30-50%)
b. Torulopsis glabrata
c. Staphylococcus aureus
d. Klebsiella
e. Enterococci

VI. SEPTIC COMPLICATIONS

A. Septic complications related to the subclavian catheter are often simple to detect. Symptoms include:

1. Fevers (usually grater than 38.5 degrees C or 101 degrees F)
2. Shaking chills
3. Glucose intolerance

Patients with pre-existing fevers may demonstrate superimposed acute temperature elevations and chills.

B. If sepsis occurs:

1. Remove catheter
2. Culture the patient's blood, catheter tip and solution

GASTROINTESTINAL

I. INTRODUCTIONS

If the gastrointestinal tract can be safely used for nutritional support and the patient tolerates enteral solutions, the enteral route is the preferred route, as it avoids all septic complications associated with parenteral nutrition.

A. Tube feeding routes

1. Transnasal (nasogastric, nasoduodenal, nasojejunal) feeding tube passage into the stomach or small intestine may cause irritation in the nasal passages, pharynx and esophogus and may compromise the gastroesophageal sphincter.

2. Feeding ostomies (esophagostomy, gastrostomy, jejunostomy) require surgical insertion. They are generally indicated when obstruction makes nasal insertion impossible or when long term feeding is anticipated. Excoriation and infection are potential complications in gastrostomies and jejunostomies since their surgical opening penetrates the peritoneum. Since the peritoneum is not entered for the cervical esophagostomy, problems with drainage and skin excoriation are diminished.

3. Nasogastric, esophagostomy and gastrostomy feedings allow the digestive process to begin in the stomach. The stomach empties its contents at a controlled rate, thus decreasing the risk of dumping syndrome. These gastric feedings are more easily aspirated than intestinal feedings since only the gastroesophogeal sphincter is operating to prevent gastric reflux.

4. Nasoduodenal, nasojejunal or jejunostomy feedings take advantage of both the gastroesphogeal and pyloric sphincters in decreasing the incidence of regurgitation and therefore aspiration. Adequate digestion and absorption occur in the small intestine when appropriate formulas are selected. The bactericidal effect of hydrochloric acid in the stomach, however, is bypassed. Thus special attention must be paid to formula preparation and equipment sanitation.

B. Formula Storage

1. Canned or bottled products should not be stored at a temperature exceeding approximately 85 degrees F (30.5 degrees C). Prolonged storage at higher temperatures can cause activation of heat sensitive spores that are not destroyed by usual heat sterilization during manufacturing.

2. Modular powdered products should be stored in a cool, dry environment. Unused powders should be covered during storage, labeled with the date of opening, and discarded periodically.

3. Prepared formulas should be refrigerated if not used immediately.

4. Opened but unused products should be labeled with the date and time of opening, covered, refrigerated, and discarded if not used within 12-24 hours.

C. Feeding Systems

1. "Closed" feeding systems are preferable to "open" systems; fresh feeding systems should be hung every 24 hours.

2. Rinse the feeding container with fresh tap water between additions of feeding solutions if small volumes are to be added periodically.

3. Feedings that have been prepared using clean techniques and that have been unopened on the ward can usually be hung safely at the bedside for approximately 8-12 hours. Feedings prepared from powdered products or modules can probably be hung safely for 6-8 hours.

4. Never add a new supply of formula to already hung formula.

D. Complications of Enteral Feedings

1. Aspiration

   a. Elevate patient's head at least 30 degrees
   b. Consider feeding beyond the gastric pylorus
   c. Use a small bore feeding catheter

2. Infectious complications

   a. Otitis media and sinusitis are possible infectious complications of nasal tube placement. Change the feeding tube placement if these complications occur.

   b. Diarrhea may or may not be of infectious origin. If a non-infectious cause cannot be identified, stool specimens should be sent for Clostridium deficile, pathogenic micro-organisms and ova and parasite determinations.

E. Culturing

1. Routine culturing of feedings is not recommended.

2. Culturing the feeding solution should be done only as part of the evaluation of a febrile enterally fed patient.

3. Culturing multiple feeding solutions is useful for tracking the source of an infectious outbreak caused by nosocomial pathogens.

RFERENCES - INFECTION CONTROL

luez R M. A Manual of Nutritional Support, 1982.

Grant JP. Handbook of Total Parenteral Nutrition, 1980.

Proceedings of the Ross Laboratories Workshop on Contamination of Enteral Feeding Products During Clinical Use, "Guidelines for Preventing Contamination of Enteral Feedings," 1983.

"Guidelines for Use in Hyperalimentation," Hospital Infection and Microbiological Control Sections, Bacterial Diseases Branch, Bureau of Epidemology, CDC, May 1972, Reprinted Dec. 1973, Reprinted March 1975.

Kaminski M, Stolar, M H. "Parenteral Hyperalimentation - A Quality of Care Survey and Review," Amer Int Hosp Pharm., 31:228-235, March 1974.

"Infection Control in Hyperalimentation Therapy," National Associate Infection Study, Third quarter, May 1972.

Simmons, B P. "Guidelines for Prevention of Intravascular Infections" CDC, October 1981.

Allen J R. "The Incidence of Nosocomial Infections in Patients Receiving Total Parenteral Nutrition," Reprinted by the U. S. Department of Health and Human Services, Public Health Service, From Advances in Parenteral Nutrition Proceedings of an International Symposium held in Bermuda, 16-19 May 1977.

APPENDIX I

HYPERALIMENTATION CHECKLIST

(1) Hyperalimentation should only be initiated after the following data are available. (According to V.A. Central Office guidelines, and according to national standards of the American Society for Parenteral and Enteral Nutrition).

_____ Nutritional Assessment

_____ Baseline height and weight

_____ Anergy battery

_____ Chest x-ray showing proper placement of central line with documentation noted in chart.

LAB DATA: _____ CBC with diff.

_____ SMA-7

_____ SMA-12

_____ Triglycerides (without lipid profile)

_____ Magnesium

_____ TIBC/Fe

_____ Prothrombin time

(2) Orders to accompany TPN start:

_____ Vital signs q shift

_____ Strict I & O's

_____ Urine S & A's q shift

_____ Urine specific gravity q shift

_____ Daily weights

(3) Suggested laboratory data follow-up:

_____ Daily SMA-7 x 7, then twice weekly

_____ Weekly SMA-12, Magnesium, TIBC/Fe, 24 hour urine UN, Cr, CBC with Diff

_____ Dressing changes every 48-72 hours.

APPENDIX II

MEDICAL RECORD

DOCTOR'S ORDERS

DATE AND TIME | TIME (24 hr.) | ORDERS | ✓ | NURSE'S SIGNATURE

PARENTERAL NUTRITION ORDERS

A. BASE SOLUTIONS (per liter)

		FINAL CONCENTRATION
1. ____	250 gm Dextrose	25% Dextrose
	42.5 gm Amino Acids	4.25% Amino Acids
2. ____	235 gm Dextrose	23.5% Dextrose
	67 gm Amino Acids	6.7% Amino Acids
3. ____	100 gm Dextrose	10% Dextrose
	27.5 gm Amino Acids	2.75% Amino Acids

*PLEASE NOTE: Renal and hepatic disease deserve special considerations. Please consult the nutrition support Pharmacist for solution availability.

B. ELECTROLYTE COMPOSITION (per liter)

1. Every Liter		2. One Liter Daily	
NaCl	(meq) ____	Calcium Gluconate	(meq) ____
NaAc	(meq) ____	Mag Sulfate	(meq) ____
KCl	(meq) ____	Trace Elements	(ml) ____
KAc	(meq) ____	MVC 9+3 (dose = 10ml)	____
K Phos	(meq K) ____	Folic Acid	(mg) ____
Heparin	(units) ____	____	____
Insulin	(units) ____	____	____
____	____	____	____
____	____	____	____

C. Flow Rate: _____ ml/hr

D. Intralipid 10%, 20% (circle one) to infuse _____ over 4-6 hours, Or at _____ ml/hr.

Physician's signature _____

PATIENT IDENTIFICATION — TREATING FACILITY — WARD NO. — DATE

88

MEDICAL RECORD

DOCTOR'S ORDERS

VA FORM OCT 1975 10-1158

EXISTING STOCK OF VA FORM 10-1158, MAY 1973, AND VA FORM 10-1158c, NOV 197 WILL BE USED

APPENDIX III

INTAKE AND OUTPUT

Large glass 240 ml. Cup: 150 ml.
Small glass 125 ml. Milk Carton: 240 ml.

Soup & Cereal: 180 ml
Jello: 120 ml
Ice Cream: 90 ml

	INTAKE								OUTPUT					
HOUR	AMOUNT OF FLUIDS DRUNK	IV	IV	NAS	IVPB	TUBE FEEDING	ORAL	IRRIGATION	URINE	STOOL	NG	EMESIS	DRAIN	OTHER
7 A.M.														
8 A.M.														
9 A.M.														
10 A.M.														
11 A.M.														
12 P.M.														
1 P.M.														
2 P.M.														
3 P.M.														
8 HR. TOTAL														
4 P.M.														
5 P.M.														
6 P.M.														
7 P.M.														
8 P.M.														
9 P.M.														
10 P.M.														
11 P.M.														
8 HR. TOTAL														
12 A.M.														
2 A.M.														
4 A.M.														
6 A.M.														
8 HR. TOTAL														
24 HR. TOTAL														

NAME: P.M. DATE:

PATIENT CARE SUMMARY (NURSING)

ADMISSION DATA
FOR
THE NUTRITIONALLY COMPROMISED PATIENT (ACTUAL OR POTENTIAL)

Date of Admission: _____
Date of Transfer: _____
* Admission Vital Signs: T- P- R- BP-
HT- WT-

* Chief Complaints: INCLUDE -NAUSEA, VOMITING, DIARRHEA, ANOREXIA, DYSPHAGIA, DIFFICULTY CHEWING, CHRONIC CONSTIPATION, ABNORMAL STOOLS.
INCLUDE LENGTH OF TIME ANY OF THE ABOVE CONDITIONS HAVE EXISTED

* Physical Disabilities: ANY RADICAL HEAD OR NECK SURGERY THAT MAKES CHEWING AND/OR SWALLOWING DIFFICULT.
PRESENCE OF DECUBITI.

Glasses: _____ Dentures: NOTE ABSENCE OF OR ILL-FITTING DENTURES.

* Other Prosthesis: NOTE THE PRESENCE OF ANY TYPE FEEDING TUBE

Important Phone Numbers:

DIAGNOSTIC PROCEDURES

TPR: _____
R/P: _____
Activity: _____
Bath: _____

SPECIAL CARE

Clinitest: _____
Isolation: _____
Dressings: _____
Seizure Precautions: _____
Other: _____

Positioning: _____

NUTRITION

Diet: _____
Supplements: _____

Assist with meals: _____
I & O: _____
Weight (specify frequency): _____

Surgical Procedures: _____

ELIMINATION

Bowel: _____
Bladder: _____
a. Foley: _____
b. External: _____

Referrals: _____

* Allergies: ESPECIALLY FOOD ALLERGIES OR INTOLERANCES

NAME _____

SS# _____

VA FORM 10-9[illegible] [illegible]

PATIENT CARE SUMMARY (NURSING)

THE PATIENT ON PARENTERAL NUTRITIONAL SUPPORT (TPN)

Date of Admission:
Date of Transfer:
Admission Vital Signs:

Chief Complaints:

Physical Disabilities:

Glasses: Dentures:

Other Prosthesis:

Important Phone Numbers:

DIAGNOSTIC PROCEDURES

NAME

VA FORM 10-9[illegible]

*TPR: Q SHIFT - REPORT T>101° (F)
*B/P: Q SHIFT
*Activity: UP IN CHAIR OR AMBULATING AT LEAST Q SHIFT, IF ABLE
Bath:

SPECIAL CARE

*Clinitest: Q6h -5A-11A-5P-11P- USE TESTAPE OR KETODIASTIX.
Isolation:
*Dressings: CVP OR PERIPHERAL SITES Q4&-72h.
Seizure Precautions:
*Other: URINE SPECIFIC GRAVITY Q6H(5A-11A-5p-11p). MOUTH CARE Q SHIFT. ROM EXERCISES QD FOR BED PTS.
*Positioning: TURN Q 2h IF ON BEDREST

NUTRITION

*Diet: NPO OR PO DIET. MAY INCLUDE TUBE FEEDINGS.
Supplements: AS ORDERED
*Assist with meals: ENCOURAGE ADEQUATE INTAKE; IF ORDERED.
*I & O: Q SHIFT
*Weight (specify frequency): DAILY AT 6AM - ON THE SAME SCALE EVERY DAY.
Surgical Procedures:

ELIMINATION

Bowel:
Bladder:
a. Foley:
b. External:

Referrals:

Allergies:

SS#

VA FORM 10-908 (578) (6-80)

T.P.N.

NURSING CARE PLAN

DATE	PATIENT PROBLEM(S)	PLANS	GOALS	SIGNATURE	date problem resolved
1)	Potential for Infection	-Change Drsg. every 48 hrs.	Patient will remain free of		
	R/T CVP Catheter	According to procedure	infection throughout TPN		
	Insertion Site	-Change IV Tubing every 48h	therapy.		
		(every 24h when using fat			
		emulsions concurrently)			
		Maintain sterility by			
		keeping a closed system			
		and securely taping all			
		connections.			
		-Observe insertion site			
		during drsg. changes for			
		redness, swelling, leaking			
		or purulent drainage --			
		document and report to MD			
		any abnormalities			
		VS every shift - Report			
		T↑ 101° F(o)			

DISCHARGE PLANS:

MARITAL STATUS: M S D W

OCCUPATION:

Room No. | SS#: | NAME: | DIAGNOSIS: | PHYSICIAN: | AGE: | RELIGION:

VA FORM 10-908 (578) (6-80)

NURSING CARE PLAN T.P.N.

DATE	PATIENT PROBLEM(S)	PLANS	GOALS	SIGNATURE	date problem resolved
2)	Knowledge Deficit R/T T.P.N. Treatment	-Explain all procedures to the patient. -Explain the purpose and goal of T.P.N. Tx. -Teach the patient the importance of compliance with the Tx. and cooperation with monitoring of the Tx's effect (e.g. I&O, S&A, specific gravity, blood drawing, daily Wts, Importance of IVAC machine -Instruct patient to tell you of any leaking at the insertion site, pain, swelling, tenderness or other untoward effects.	-Will be able to verbalize a) What TPN is for and b) Why he is receiving it within 1-2 days of initation of therapy. -Will comply and cooperate with the Tx. for its entire course of therapy.		

		DISCHARGE PLANS:	MARITAL STATUS: M S D W
Room No.	SS#		OCCUPATION
	NAME:	ADMISSION: DISPOSITION:	AGE:
			RELIGION:

VA FORM 10-908 (578) (6-80)

T.F.N.

NURSING CARE PLAN

DATE	PATIENT PROBLEM(S)	PLANS	GOALS	SIGNATURE	date problem resolved
3)	Potential for excess fluid volume R/T TPN infusion	-Monitor TPN infusion rate through the use of IVAC Pump.	Patient will maintain adequate fluid volume throughout course of therapy		
		-Do not "catch up" infusion rate by increasing the rate more than 5-10%			
		-Check pump & fluid level in IV bag every 1 hr, for proper rate.			
		-Daily wts, specific gravity every 6 hrs., I&O every shift, S&A every 6hrs. to monitor for fluid overload			
		-Observe for shortness of breath, Dyspnea, Tachycardia new onset or increase in peripheral edema, cyanosis, mental status changes, glycosuria and notify MD.			

DISCHARGE PLANS:

MARITAL STATUS: M S D W

OCCUPATION:

Room No.:

SS#:

NAME:

DIAGNOSIS:

PHYSICIAN:

AGE:

RELIGION:

46

VA FORM 10-908 (578) (6-80)

NURSING CARE PLAN T.P.N.

DATE	PATIENT PROBLEM(S)	PLANS	GOALS	SIGNATURE	date problem resolved
4)	Potential for fluid volume deficit R/T Hyperosmolar concentration of TPN soln.	-Monitor I & O every shift to assess for increased output.	Patient will remain adequately hydrated throughout course of therapy		
		-S & A every 6hrs., specific gravity every 6hrs. & report any abnormalities to MD.	Patient will show no signs of hyperglycemic reactions.		
		-Monitor for; dry warm skin, increasingly dry mouth, poor skin turgor confusion Disorientation Lethergy and report to MD.			

96

		DISCHARGE PLANS:		MARITAL STATUS: M S D W
Room No.	SS#:			OCCUPATION:
	NAME:	DIAGNOSIS:	PHYSICIAN:	AGE:
				RELIGION:

PATIENT CARE SUMMARY (NURSING)

THE PATIENT ON ENTERAL NUTRITIONAL SUPPORT

Date of Admission: _____
Date of Transfer: _____
Admission Vital Signs: _____

Chief Complaints: _____

Physical Disabilities: _____

Glasses: _____ Dentures: _____

Other Prosthesis: _____

Important Phone Numbers: _____

DIAGNOSTIC PROCEDURES

NAME _____

*TPR: Q Shift - Report T> 101 °(F)
*R/P: Q Shift
*Activity: UP IN CHAIR IF TOLERATED OR TURN Q2h IF ON BEDREST
Bath: _____

SPECIAL CARE (5A-11A-5P-11P)

*Clinitest: BID - 6AM + 6PM - QID, IF PT. DIABETIC
Isolation: _____
*Dressings: CHANGE G-TUBE OR J TUBE DRSG. PER MD ORDER- AT LEAST DAILY
Seizure Precautions: _____
*Other: MOUTH CARE - TID or QID. ASPIRATE TUBE FOR RESIDUAL (>50ML) BEFORE EACH FDG. CHECK RATE Q1-2 HRS.
*Positioning: HOB 30° OR> DURING FEEDING AND FOR 2 HRS. AFTERWARDS.

NUTRITION

*Diet: TUBE FEEDING AND P.O. DIET (IF ORDERED)
*Supplements: FLUSH TUBE WITH AT LEAST 100cc WATER Q SHIFT
*Assist with meals: ENCOURAGE P.O. REFILL BAG WITH 4-8h. FDG SUPPLY
*I & O: EVERY SHIFT
*Weight (specify frequency): DAILY FOR THE FIRST 2 WEEKS, THEN 2-3x/week at 6am.
Surgical Procedures: _____

ELIMINATION

Bowel: _____
Bladder: _____
a. Foley: _____
b. External: _____

Referrals: _____

Allergies: _____

SS# _____

96

VA FORM 10-9[illegible]

VA FORM 10-908 (ST8) (6-80)

ENTERAL NUTRITION

NURSING CARE PLAN

DATE	PATIENT PROBLEM(S)	PLANS	GOALS	SIGNATURE	date problem resolved
1)	Potential for infection	-Change dressing over	Patient will remain free of		
	R/T feeding tube insertion	insertion site per orders,	infection throughout		
	site (jejunostomy or	at least daily.	therapy.		
	Gastrostomy)	-Note any redness, swelling			
		leaking of gastric content			
		Pain or tenderness, or purulent			
		drainage at the site &			
		report.			
		-Monitor temperature Avery			
		4 houre X 72h. p̄ insertion			
		& report T↑101° (o)			

Room No.	SS#:	DISCHARGE PLANS:		MARITAL STATUS: M S D W
	NAME:	DIAGNOSIS:	PHYSICIAN:	OCCUPATION:
				AGE:
				RELIGION:

-66-

VA FORM 10-908 (578) (6-80)

ENTERAL NUTRITION

NURSING CARE PLAN

DATE	PATIENT PROBLEM(S)	PLANS	GOALS	SIGNATURE	date problem resolved
2)	Potential for aspiration R/T type of tube & placement (especially Nasogastric or Gastrostomy)	-Elevate head of bed 30° - 45° during feeding and for at least 2 hours afterwards to allow for gastric emptying. -Aspirate stomach contents before each feeding to check for residual and proper placement - Do not feed if residual > 50ml. -Observe for any shortness of breath, dyspnea, N or V, cyanosis - turn off feeding and notify MD.	Patient will not develop pulmonary complications as a result of aspiration during feeding throughout the course of therapy.		

		DISCHARGE PLANS:		MARITAL STATUS: M S D W
Room No.	SS#:			OCCUPATION:
	NAME:	DIAGNOSIS:	PHYSICIAN:	AGE:
				RELIGION:

86

VA FORM 10-908 (578) (6-80)

ENTERAL NUTRITION

NURSING CARE PLAN

DATE	PATIENT PROBLEM(S)	PLANS	GOALS	SIGNATURE	date problem resolved
3)	Potential for alteration in	-Check rate of infusion	Patient will have minimal		
	bowel elimination:	of feeding every 1-2hr for	or no Diarrhea during the		
	diarrhea R/T tube feedings	proper rate. Do not	course of therapy.		
		increase rate >5-10 %			
		-Use an infusion monitoring			
		device, if available.			
		-Aspirate for residual			
		before each feeding.			
		-Monitor I & O every shift.			
		-Do not hang more than an			
		8 hour supply of feeding to			
		prevent bacterial growth.			
		Rinse tubing & bag p each			
		feeding. Change tubing &			
		bag every 24 hours.			
		-Report unchecked diarrhea			
		to MD for rate or concentration adjustment.			

		DISCHARGE PLANS:		MARITAL STATUS: M S D W
Room No.	SS#:			OCCUPATION:
	NAME:	DIAGNOSIS:	PHYSICIAN:	AGE:
				RELIGION:

66

VA FORM 10-908 (578) (6-80)

ENTERAL NUTRITION

NURSING CARE PLAN

DATE	PATIENT PROBLEM(S)	PLANS	GOALS	SIGNATURE	date problem resolved
4)	Knowledge deficit R/T caring for tube and administering own feeding	When patient and/or family appears ready, begin to teach feeding administration and tube insertion site care -Stress importance of consuming prescribed caloric intake daily to maintain or gain Wt. -Refer to NST Dietitian for follow-up. -Discuss complications (i.e., diarrhea, N or V, infection, dehydration, etc) and interventions to remedy problems.	Patient and/or family will be able to give adequate return demonstration of tube feeding and tube care by the day prior to discharge. Patient and/or family will be able to verbalize the caloric requirements and possible complications of therapy and their interventions by the day prior to discharge.		

001

		DISCHARGE PLANS:		MARITAL STATUS: M S D W
Room No.	SS#:			OCCUPATION:
	NAME:	DIAGNOSIS:	PHYSICIAN:	AGE:
				RELIGION:

VA FORM 10-908 (ST6) (6-80)

ENTERAL NUTRITION

NURSING CARE PLAN

DATE	PATIENT PROBLEM(S)	PLANS	GOALS	SIGNATURE	date problem resolved
5)	Potential for fluid volume	-Mouth care 3-4 times a day. -Monitor I & O every shift	Patient will receive		
	deficit R/T administration	observe for excess output & report.	adequate fluid volume and		
	of feedings.	-Daily WTS. X 2 WKS, then 3 X WK. if feeding tolerated.	will not exhibit signs of		
		-VS every shift & report	dehydration during the		
		T> 101 F(O) hypo tension or Rapid pulse to MD.	course of therapy.		
		-Free water of at least 30 ML. every 4 hr. should be given through the tube.			
		-Check rate of infusion			
		every 1-2hr. for proper			
		rate.			
		-Observe for warm, dry,			
		skin, lethargy, confusion,			
		hypoglycemia & report.			

101

		DISCHARGE PLANS:		MARITAL STATUS: M S D W
Room No.	SS#:			OCCUPATION:
	NAME:	DIAGNOSIS:	PHYSICIAN:	AGE:
				RELIGION:

VA FORM 10-908 (578) (6-80)

ENTERAL NUTRITION

NURSING CARE PLAN

DATE	PATIENT PROBLEM(S)	PLANS	GOALS	SIGNATURE	date problem resolved
6)	Potential for alteration in	-Daily WTS X2 WKS, then	Patient will receive		
	fluid volume: Excess R/T	3X/WK if feeding tolerated -Monitor I & O every shift,	adequate fluid volume and		
	administration of feedings.	(6A-6P) (5A,11A, 5P, 11p) -S & A BID; or QID if	will not exhibit signs of		
		patient is a diabetic, report glycosuria	fluid overload during the		
		-Check rate of infusion every 1-2 hr. Do not adjust	course of therapy.		
		rate > 5-10% -Use an infusion device, if			
		available. -Administer feedings per			
		MD order.			
		-Observe for signs of			
		hyperglycemia and report.			
		-VS every shift			
		-Observe for shortness of			
		breath, dyspnea, cyanosis,			
		presence or increase in			
		peripheral edema, N or V,			
		tachycardia or confusion			
		and report.			

DISCHARGE PLANS:

MARITAL STATUS: M S D W

Room No. SS#:

OCCUPATION:

NAME: DIAGNOSIS: PHYSICIAN:

AGE:

RELIGION:

102

☆U.S. GOVERNMENT PRINTING OFFICE: 1986-642-167